World's Greatest Places

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THE MAGAZINE DIVERS TRUST

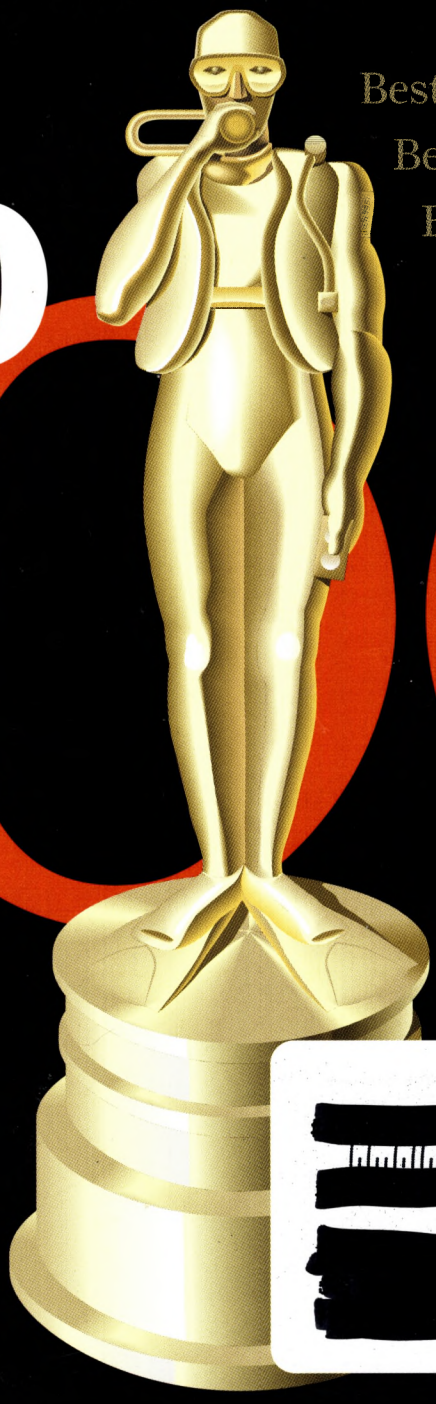
SCUBADIVING.COM JANUARY/FEBRUARY 2004

END EAR PAIN FOREVER, P. 93

top 100

Best Values • Best Marine Life
Best Visibility • Best Walls
Best Wrecks and More!

Annual Readers' Choice Awards

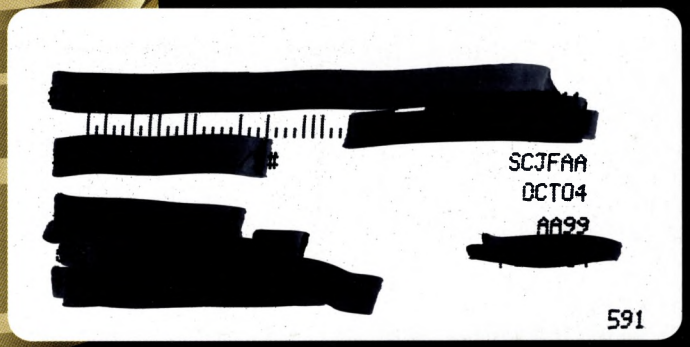


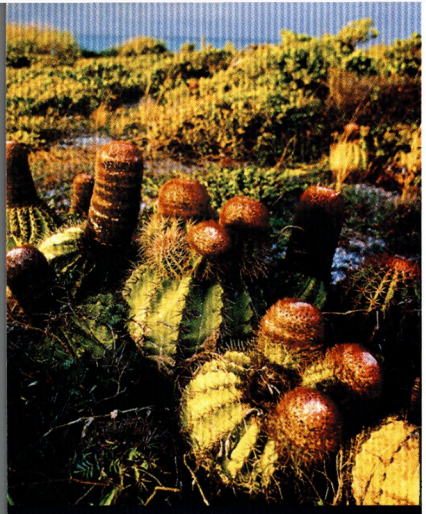
PLUS:

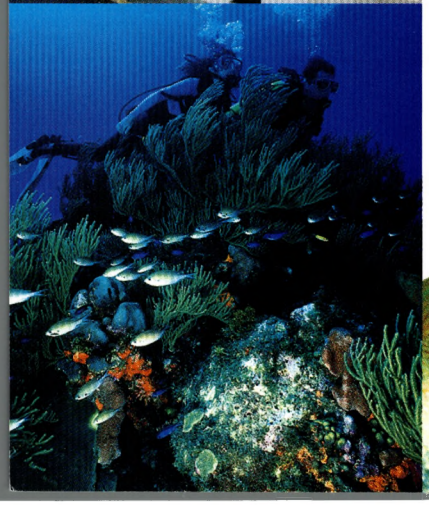
STAY WARM ON ANY DIVE

8 BACKUP BREATHERS

HIGH DRAMA IN BONAIRE







You're not dreaming You're in Puerto Rico

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RODALE'S SCUBA DIVING

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Our readers voted Bonaire the best diving in its region. For more superlatives, see our Top 100.

CHRIS JAFFE

48 Top 100 Our exclusive report on the world's top dive destinations as determined by the most discriminating critics we know: our readers.

DIVE LOG

58 Papua New Guinea From pelagic-rich seamounts to World War II wrecks to the primal landscape of the Southern Highlands, we'll take you on a tour so vivid you can almost taste the betel nut. ***By Stuart and Michele Westmorland***

64 Cold Comfort The secrets to staying warm under water are pretty much the same whether you're diving beneath the Antarctic ice pack or in the pool at the YMCA. Here's all you need to know. ***By John Francis***

LESSONS FOR LIFE

68 A Fatal Miscalculation Bill ran the numbers and decided he could break one of tech diving's cardinal rules of safety. The numbers didn't lie, but they also didn't account for an unplanned emergency. ***By Michael Ange***

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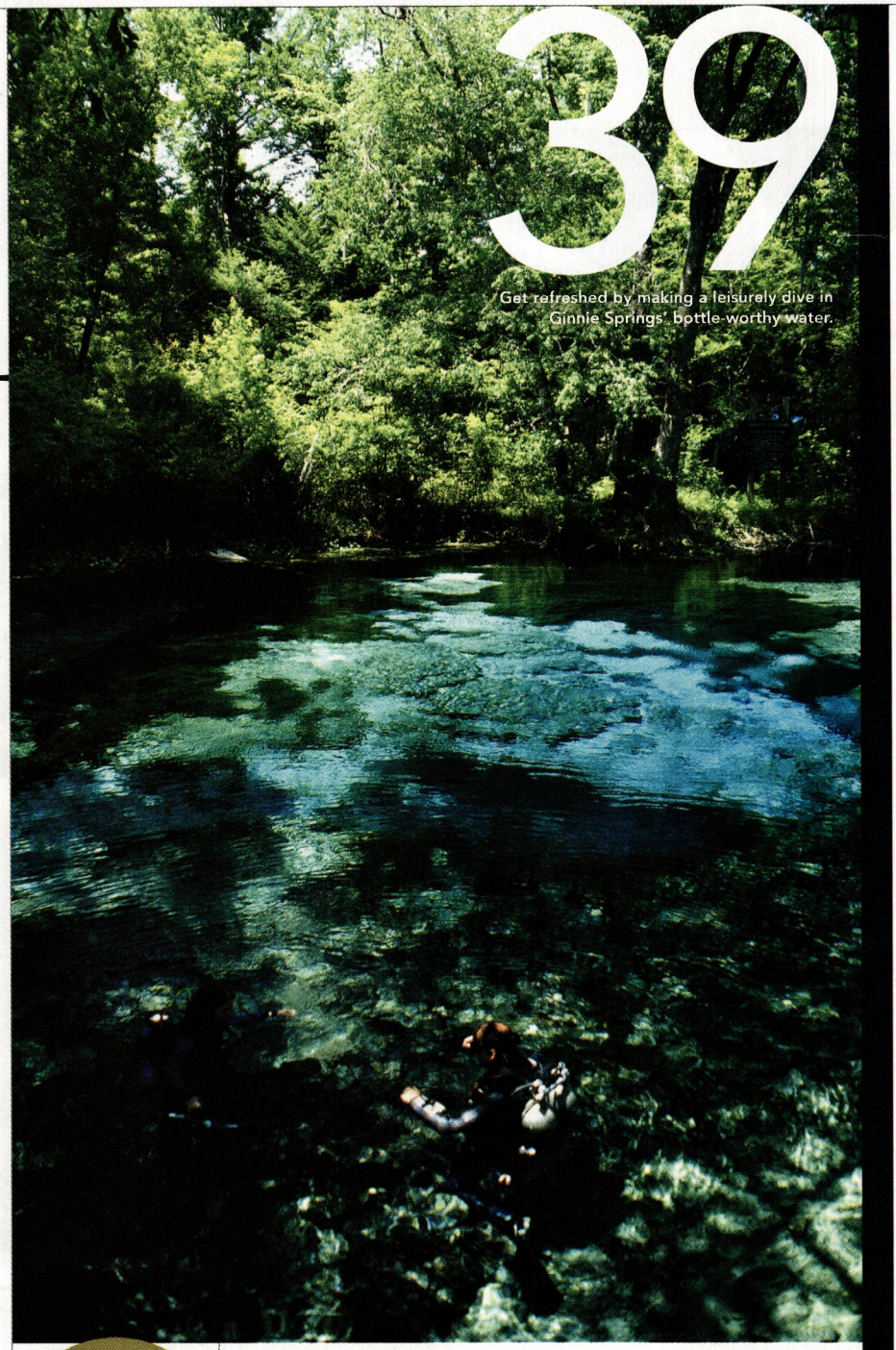

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Get refreshed by making a leisurely dive in Ginnie Springs' bottle-worthy water.

TIM O'KEEFE

THE GREAT DIVES

15 THE MASSIVE WRECK of the *Bianca C* off Grenada; the stunning reefs of Myanmar's Mergui Archipelago; and the manatee playgrounds of Florida's Crystal River.

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7 TALK 88 SNAP 99 IN DEPTH 104 LOOK

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T A L K

(EDITOR'S NOTE)

Winners' Circle

The key to our annual Readers' Choice Awards is readers. **BY BUCK BUTLER**

MONTHS AGO, when we scheduled travel features on Bonaire and Papua New Guinea for this issue, we had no idea that those same two destinations would show up in two of the top spots in our annual Readers' Choice Awards, which also appear in this issue. But, by happy coincidence, they did.

In fact, we have no idea what's going to end up in our Top 100 until a couple of weeks before we put the finishing touches on this issue. Before crunch time, we spend months sorting through thousands of survey forms and entering the raw data that forms the basis for our annual review of the world's best dive destinations. (I shouldn't say "we," really, when the credit goes to the tireless fingers of data-entry techs Paula Baumgartner and Traci Fisher.)

Those surveys come from some of the most experienced and well-traveled divers in the world: our readers. In other words, you've done the hard work—spending your own money, traveling the world, diving and rating your experiences. Now it's time for you to reap the rewards. We hope you'll hang on to this issue and refer back to it periodically through the year. Use the Top 100 as a wish list of destinations that you might want to explore, sorted by areas of interest—wreck diving, wall diving, big animal encounters and more.

Study the results, make your choice, then get out there and dive. And when you get home, be sure to fill out a Reader Ratings form to let us know how it was. We'll be waiting, calculators in hand.

(ONLINE)

Log On and Log Your Dives

Make a New Year's resolution to log your dives in 2004. No more lame excuses like the dog ate your logbook—ScubaDiving.com makes recording your dives fun and easy with our exclusive online dive log. Watch your bottom time increase as we keep track of your dives throughout the year with this free interactive tool. Find it in the "Training" section of ScubaDiving.com.

(HOT TOPIC)

GRAVE CONCERNS

Do you consider diving on a wreck on which people have died to be either disrespectful or inappropriate? —SCUBADAVE

I have and will continue to dive wrecks where lives were lost. Of course, proper respect for human remains is appropriate—they are not souvenirs. —CAPECODDIVER Why should it differ from visiting a gravesite on land? We behave with respect, and take nothing. Divers should be capable of doing the same. —NOLATOM Respect for the dead does not preclude viewing their remains, in my opinion. Although I wouldn't specifically dive a wreck because someone died there, if it happened to be a fact of the wreck, it wouldn't stop me. —ACTOR212 I really don't know how I'd feel if I had lost a family member on a diveable wreck. I probably would never dive it, but over time, I'm not sure that I'd have a problem with others diving it. —ANITA99 Respecting the site is important and part of that respect is leaving it intact. —MARKMA

Want to join the discussion? Log on to www.scubadiving.com and click on "Community."

(LETTERS)

Tiny Bubbles

I WAS INTRIGUED BY THE NOTION of deep safety stops for recreational divers ("One Minute to Safer Diving," Dec. '03) and want to thank you for making the complex issues of decompression theory understandable. I've already started making these one-minute deep stops on my dives because it just seems like a no-brainer. So what if there's debate on the ability of a deep stop to crush tiny bubbles when you're within no-deco limits? I figure it can't hurt. If nothing else, a deep stop slows your average ascent rate, and that's a smart thing to do. Being a conservative diver by nature, I also routinely stretch my safety stops to five or seven minutes after deeper or longer dives. — **Marc Rivers, Miami, Fla.**

The Gift of Gear

AT CHRISTMASTIME, my husband always has trouble finding the right gift for me. Last year, I got a new vacuum cleaner (and that was one of his better ideas). When your Gear Guide (Dec. '03) arrived this year, I realized it was perfect for one-stop shopping. I went through the issue, circled several suggestions and left it where he would find it. I found some things for him, too. Thanks to you, our holidays will be a little brighter. (I hope.) **Whitney Edenfield, Visalia, Calif.**

Big Fish in Big Trouble

I HAVE BEEN A FAN of Lance Leonhardt's articles for a long time. His most recent story, "Predators in Peril" (Dec. '03), is a candid look at the consequences of overfishing. It should be required reading for divers and nondivers alike. **Drew Mattison, Dallas, Texas**

(HOW TO REACH US)

We want to know what's on your mind. Here are three easy ways to tell us:

E-MAIL: edit@scubadiving.com
FAX: (912) 351-0735
MAIL: Editor, Rodale's Scuba Diving, 6600 Abercorn St., Suite 208, Savannah, GA 31405

(LIST)

TOP TEN THINGS NOT TO SAY ON A DIVE BOAT

#10: "Can I keep this coral that your anchor broke off?"

#9

"Buddy? Oh, did I go down with a buddy?"

#8

"Can someone lend me a computer? Mine keeps flashing, 'Deco Violation.'"

#7

"I count seven. Are you sure there are eight names on the manifest?"

#6: "Does anyone else smell smoke?"

#5

"What do I do with this bucket of vomit?"

#4

"Could you 'warm up' my wetsuit for me?"

#3

"Macarena anyone?"

#2

"Certification smertification!"

#1: "Is that your mask under my tank?"

(From the users of www.scubadiving.com. For more Top 10 lists, go to www.scubadiving.com and click on "Community.")

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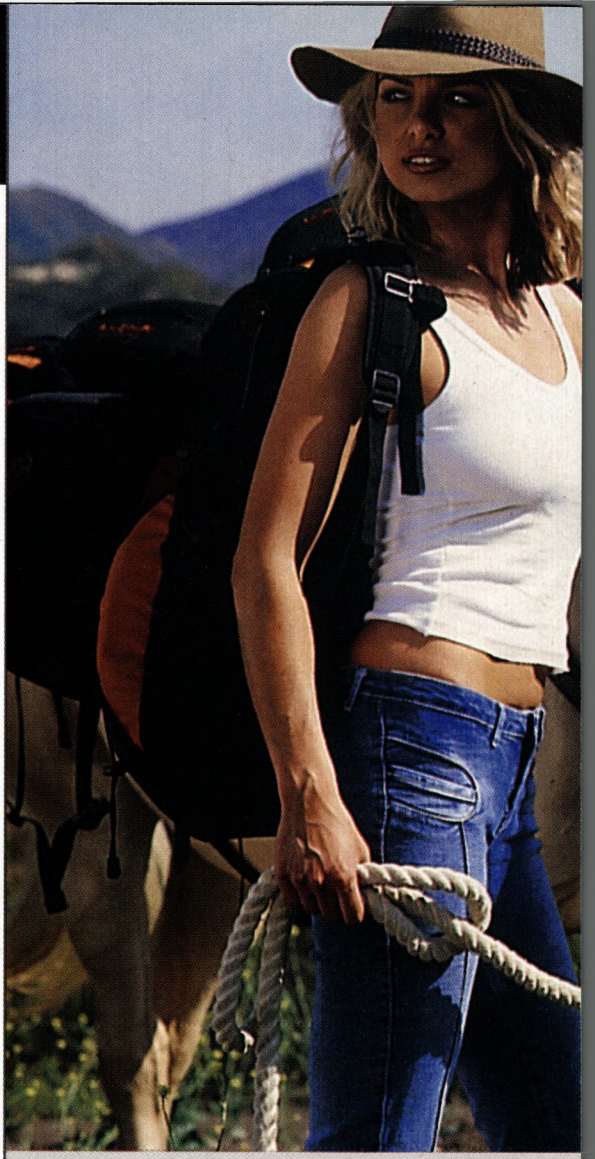

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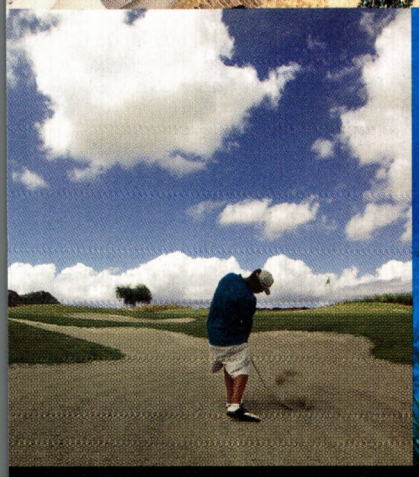

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PHOTOGRAPH BY **ETHAN GORDON**

(MYANMAR)

Mergui Archipelago

IN SOUTHEAST ASIA'S Andaman Sea, the hundreds of islands in Myanmar's Mergui Archipelago are surrounded by rich waters and inhabited only by boat-dwelling sea gypsies. Offshore, soaring pinnacles, enormous coral-crusted boulders and stately archways rise from the ocean floor, while swim-throughs and tunnels cut straight through some islands. In the complex reef structures, divers find seahorses, ornate ghost pipefish, manta and eagle rays, blue ribbon eels and giant groupers. The Andaman Sea is also well-known for its abundance of sharks—on a single dive it's possible to spot shy gray reef sharks, free-swimming nurse sharks, blacktips, bulls and spinners.

A lone jellyfish makes its way among vivid soft corals, while clouds of baitfish zip around the tiny islet Black Rock.

PHOTOGRAPH BY **BARRY KULICK**

Mind your manners when approached by a curious manatee—and snorkeling only, please.

(FLORIDA)

Crystal River

MECCA FOR FLORIDA'S West Indian manatees is Crystal River, which offers the perfect conditions for the portly sea cows—tons of soggy seagrass and warm 72-degree water. Manatees can grow to 1,000 pounds and can measure nine feet long from whiskered snout to paddle tail. These gentle aquatic mammals spend a good part of their day grazing on seagrass and algae. You'll see the greatest number of manatees from December through April. SD

GET THERE > For more information on these great dives, turn to In Depth, page 99, section 1.

PHOTOGRAPH BY **TOM STACK**

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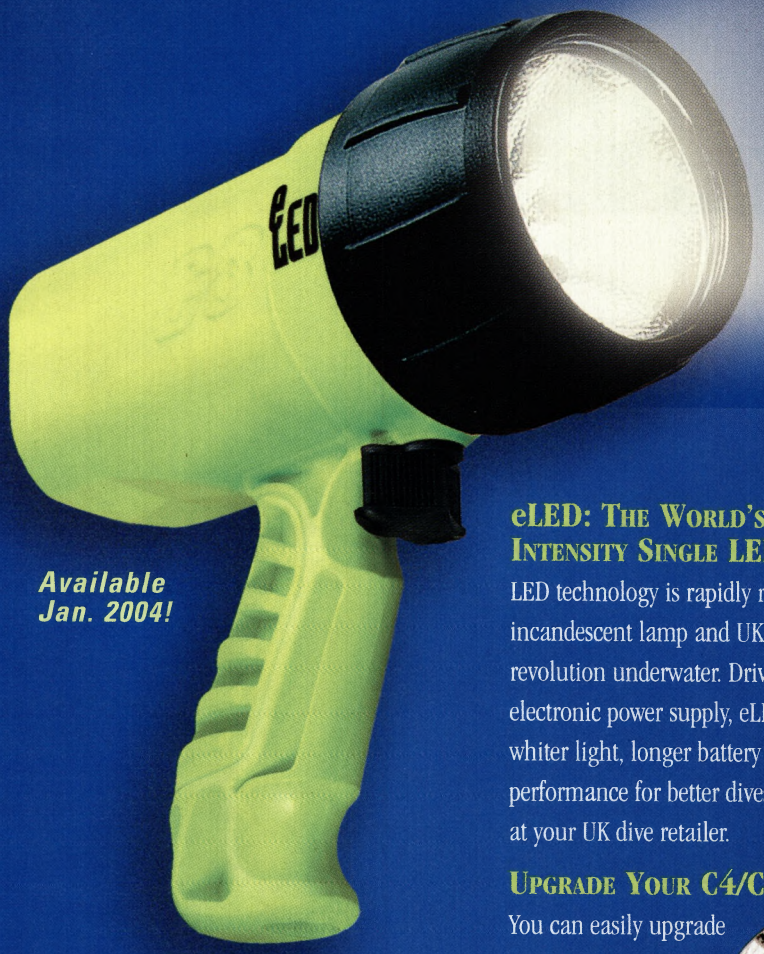

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With backing from the National Science Foundation, photographer Norbert Wu helicoptered to the edge of this ice channel to photograph and dive with this pod of orcas.

nts

PHOTOGRAPH BY **NORBERT WU**

(EXPLORATION)

Orca Alley

Where whales tread on thin ice.

In McMurdo Sound, Antarctica, the austral summer arrives each January accompanied by the sound of cracking ice and the sight of hunting orcas.

Bombarded by four months of continuous sunlight, the sea ice that once covered 7 million square miles shrinks to a mere 1 million square miles. And as the ice breaks up, orcas prowl the newly formed edges for prey ranging from Weddell seals and penguins to the giant Antarctic cod, *Dissostichus mawsoni.*

"I've watched large groups of orcas work one area of the ice edge, diving repeatedly down and under the sea ice," says Jim Mastro, a diving officer for the National Science Foundation's McMurdo Station research base and a keen observer of Antarctic marine life. "They can't get deep enough into the ice to stand much of a chance to get Weddell seals ... but we do know that there are *mawsoni* hanging out under the fast ice, and there is no bigger, juicier treat than one of them."

Channels like the one pictured here can run for miles into the ice pack, giving the whales a chance to hunt in areas off-limits during the colder months. But, as air-breathing mammals, these killer whales are taking considerable risks to get food. The ice channels and holes they explore can close up within minutes, leaving them trapped without access to the surface. Sometimes, the whales will rest within small pools of open water for hours, waiting for the ice around them to clear so that they can swim back to the open ocean. Other times, a pod will spyhop from an ice hole, apparently looking for a safe route back to open water. —NORBERT WU

To see more photographs from Antarctica, visit www.norbertwu.com.

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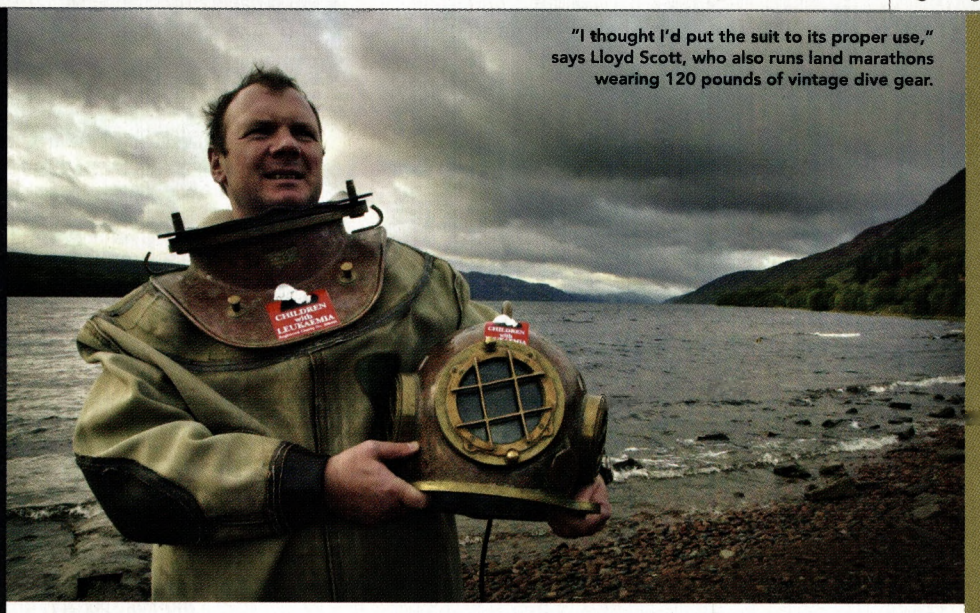

"I thought I'd put the suit to its proper use," says Lloyd Scott, who also runs land marathons wearing 120 pounds of vintage dive gear.

ANDREW MILLIGAN / ASSOCIATED PRESS

(PEOPLE)

A Walk to Remember

Lloyd Scott's underwater marathon against leukemia.

When 42-year-old Lloyd Scott sank into the chilly murk of Scotland's Loch Ness, he wasn't looking for the infamous lake monster. He was after $5 million.

In October, Scott suited up in 120 pounds of vintage hard-hat dive gear and walked 26 miles across the bottom of the lake to kick off a fund-raising campaign for the UK charity Children with Leukaemia. At a depth of 30 feet, Scott spent 12 days slogging through silt and over rocks. "It was cold, it was lonely and there was limited visibility. My air line kept getting caught, and the terrain was very hazardous at times," he says. "Sometimes I was literally walking six feet from a 300-foot sheer drop."

Of course, Scott is used to hardships in the name of charity. The former London firefighter and leukemia survivor also runs land marathons wearing vintage dive gear. He finished the 2002 London Marathon in five days, eight hours, 29 minutes and 46 seconds—the slowest time on record. —MICHAEL JORDAN

To learn more about Lloyd Scott and Children with Leukaemia, visit www.leukaemia.org.

(STAT)

$120

Estimated value, in millions, of the 20,000 gold coins on the *SS Republic*. The steamer sank off Savannah, Ga., in an 1865 hurricane. Odyssey Marine Exploration recently located the wreck and announced plans to salvage the cargo.

(EDUCATION)

The Next Generation

Underwater cameraman Dan Wagner is a man on a mission—to teach kids to care about the oceans. As founder of the Mother Ocean Foundation, the 71-year-old Floridian gives presentations to schoolkids, making use of marine life videos captured on more than 10,000 dives since the 1950s. When he's not in the classroom or rounding up corporate sponsors, Wagner is adding to the foundation's web site (www.ourmotherocean.com) and finishing his labor of love: a CD-ROM/storybook entitled *Little Things Mean A Lot*. The animated story uses the example of cleaner fish to teach kids that "each and everyone of us has to do a little bit better—then the things in the sea will get better," he says. "That's what it's all about." —PAULA BAUMGARTNER

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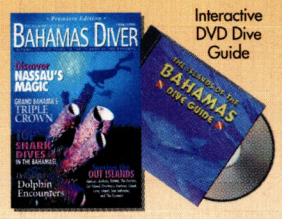

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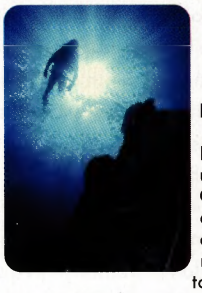

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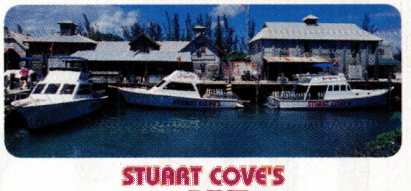

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(QUOTE)

"I've had someone throw a bomb at coral about 100 yards from where I was diving. That's no fun."

—REEF SCIENTIST THOMAS GOREAU ON THE DANGERS OF DYNAMITE FISHING, TO REEFS AND TO DIVERS, IN REMOTE ISLANDS OF THE INDO-PACIFIC

(ARTIFICIAL REEF)

END OF THE LINE

New York City subway cars retire to the ocean floor.

For New York City straphangers, October 2003 was the end of the Red Bird era; but for divers as far away as Georgia, it was only the beginning.

Last fall, New York transit officials retired from service the last of the ubiquitous red subway cars that have carried commuters to Yankee and Shea stadiums, Madison Square Garden, Lincoln Center, Carnegie Hall and Wall Street since 1962. The disposal plan calls for 1,300 of the cars to be cleaned, stripped of recyclable materials and then sunk as artificial reefs.

Under water, the 51-foot-long Red Birds create 800 to 1,000 times more habitat than the open ocean floor. Studies show that as many as 200 species of Atlantic marine life are likely to take up residence in the space where murders, weddings, births, film crews, and seas of expressionless commuters have passed for nearly five decades. Already, more than 1,000 cars have been deployed off New Jersey, Delaware, South Carolina, Virginia and Georgia, and plans call for the last of the cars to be sunk as artificial reefs in 2004. —BOB STERNER

Fifty cars are deployed at Atlantic City Reef. The site is one of five Red Bird reefs created thanks to the lobbying efforts of the New Jersey Council of Diving Clubs.

PHOTO COURTESY OF THE STATE OF NEW JERSEY

(SCIENCE)

Don't Hold Your Breath Norwegian scientists studying Australia's Great Barrier Reef recently made two startling discoveries. When they measured the amount of dissolved oxygen in the water, they discovered it dropped precipitously at night. The other discovery? It didn't bother 31 species of damselfish, cardinalfish, gobies, blennies, filefish and wrasses a bit, says Goran Nilsson, a physiologist at the University of Oslo. If you had the same tolerance for hypoxia, you could survive for hours in a room with 80 percent of the oxygen removed. And just imagine how long your tank would last. —LANCE LEONHARDT

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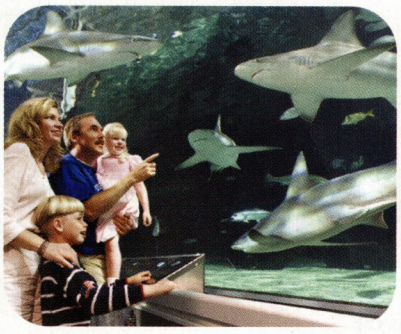

(CLOSE TO HOME)

Mall Sharks

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After a 25-minute swim, you surface briefly and transfer to Shark Cove, a 500,000-gallon saltwater aquarium that's home to 23 sharks, 11 big southern stingrays and three sea turtles, including Calypso, a 340-pound loggerhead. Safety divers shuttle divers around the exhibit, guiding you to close encounters with shark species from all over the world—blacktips, browns, nurse sharks, wobbegongs and a ferocious-looking, eight-foot sand tiger named Jessie.

In all, the experience takes about an hour and when you're done, the food court awaits. —MICHAEL JORDAN

2001 ECOREEFS.COM (RIGHT); MALL SHARK PHOTO COURTESY OF MALL OF AMERICA

(PROTECTION)

CHINA SYNDROME

Ceramic snowflakes jump-start reefs.

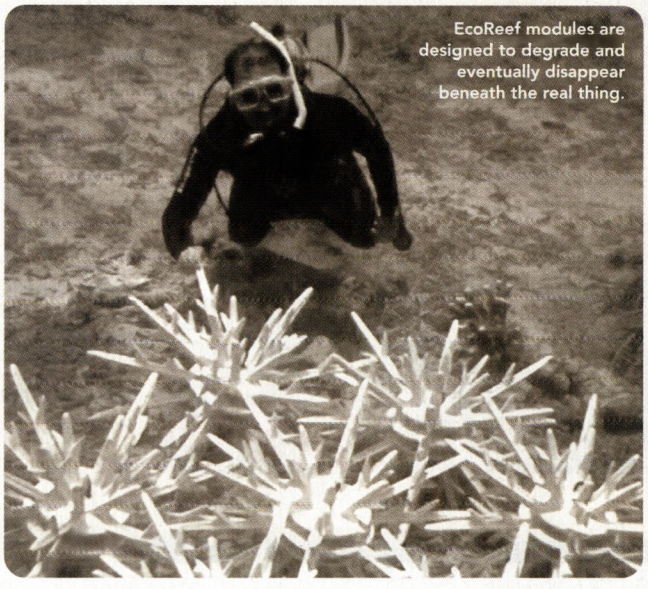
While earning a Ph.D. in integrative biology at Berkeley, Michael Moore witnessed the obliteration of Pacific reefs by dynamite fishing. "In some places, after as much as 15 years there had been no recovery at all," says the 38-year-old entrepreneur. "This got me thinking about the eco-requirements of jump-starting the process."

Moore's solution is EcoReefs—ceramic "snowflakes" that temporarily replace thickets of *Acroporid* branching corals. Unglazed and pH-neutral, the microporous stoneware provides ideal substrate for new coral growth. In time, the ceramic coral gardens are covered over by the real thing.

Assembled from precast ceramic plates, each 18- by 34-inch module sports 30 branches and weighs about 40 pounds. The cost to cover the ocean floor with an interlocking pattern of modules is about $70 a square meter—an amount easily recovered from fishing and tourism revenues, says Moore.

The first EcoReefs pilot project in Indonesia's Bunaken National Park has gone swimmingly. Little herbivorous fish, their algae-chomping essential to coral reef ecology, moved in almost immediately after the October 2001 installation. By June of 2002, coral transplants as well as new recruits were thriving on the crockery substrate.

Bolstered by these results, EcoReefs Inc. is now building a 500-square-meter reef in Indonesia and has secured funding from the Packard Foundation for a three-year reconstruction project in the Philippines. —BUCKY MCMAHON



EcoReef modules are designed to degrade and eventually disappear beneath the real thing.

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LIFE

(FISH ID)

What's This?

If you guessed rigid shrimpfish as the name of this Pacific species hiding in the stalks of sea whips, you're close, but wrong. The sharp dorsal spines on the tails of our mystery fish are hinged to move, and the shrimpfish has no such ability. Otherwise, they're identical—silvery, with brown stripes running snout to tail. Both live on reefs throughout the Indo-Asian Pacific, where they float in snout-down schools and hunt minute shrimp. But our species gets its common name from a stiff, flat body that resembles an old-school barber's blade.

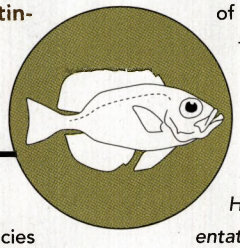
the ANSWER

RAZORFISH, *Aeoliscus strigatus.*

PHOTOGRAPH BY **NORBERT WU**

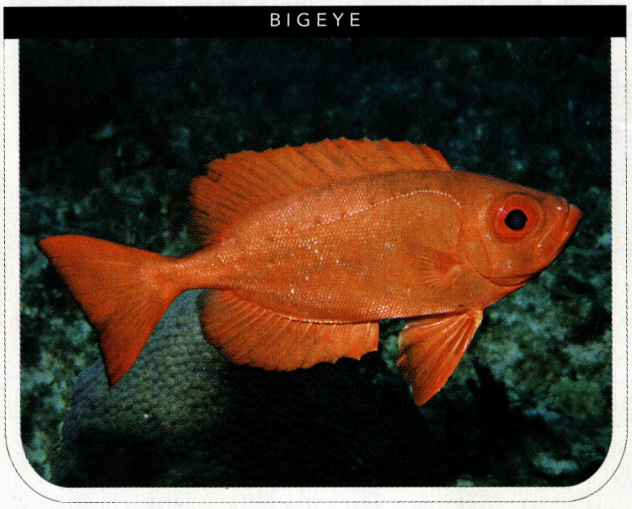
the DIFFERENCE

Not all big-eyed creatures of the night are alike. Here's how to distinguish between two of the most common.



Approximately two-thirds of reef fish species feed during the day, while the remainder forage at night. Nocturnal feeders can usually be identified by their large, light-enhancing eyes and reddish coloration, which renders them almost invisible after dark. Two striking examples of night foragers from the family *Priacanthidae*, the bigeye, *Priacanthus arenatus*, and the glasseye snapper, *Heteroriacanthus cruentatus*, are frequently sighted on Caribbean reefs.

Large, flat bodies, measuring eight to 12 inches in length, as well as intimidating arrays of long, spiny fins, provide both species with a significant degree of protection from most predators. This relative sense of security is why they show little concern toward approaching divers. In fact, a cautious observer can swim to within a few feet of bigeyes or glasseye snappers before the stately fish



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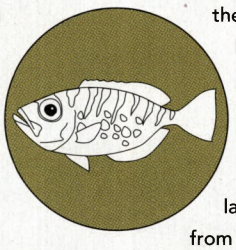
slowly turn and drift away.

At first glance, the two closely related species appear quite similar in size, color and shape, and both share an ability to pale or darken rapidly. However, bigeyes always display an even wash of red, whereas glasseye snappers, even when pale, consistently exhibit irregular bars across their reddish backs and sides.



Although the behavior of the two family members is similar, there are differences. During the day, bigeyes tend to inhabit deeper reef shelves, where they hang out in loose groups. At night, they pluck larval fishes from the plankton and also scour the bottom for shrimps, crabs and worms. Glasseye snappers spend their day at somewhat shallower depths, hovering alone near the reef or above breaks in the bottom. After dark, they dine almost exclusively on large zooplankton, including larval fishes, taken from the water column.

Bigeyes and glasseye snappers, like several other nocturnal fishes, including sharks, have a reflecting layer behind the retina known as the tapetum lucidum. The tapetum mirrors back light through the photoreceptors, greatly enhancing night vision. It is this layer that creates dazzling eye shine when the fish are illuminated by handheld lights at night. — PAUL HUMANN AND NED DELOACH

GLASSEYE SNAPPER

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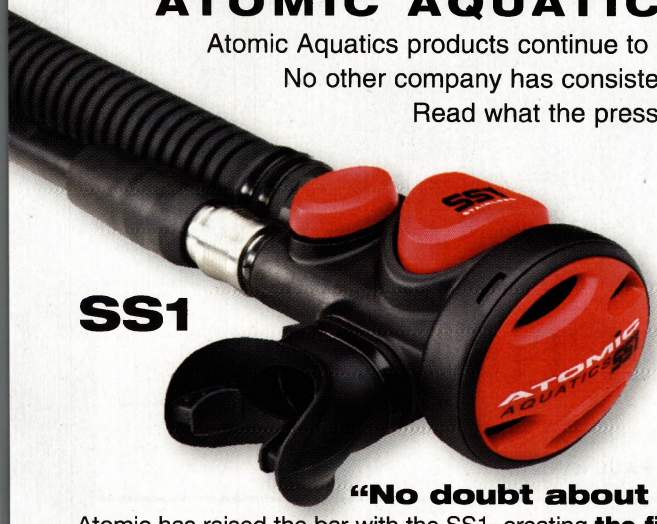

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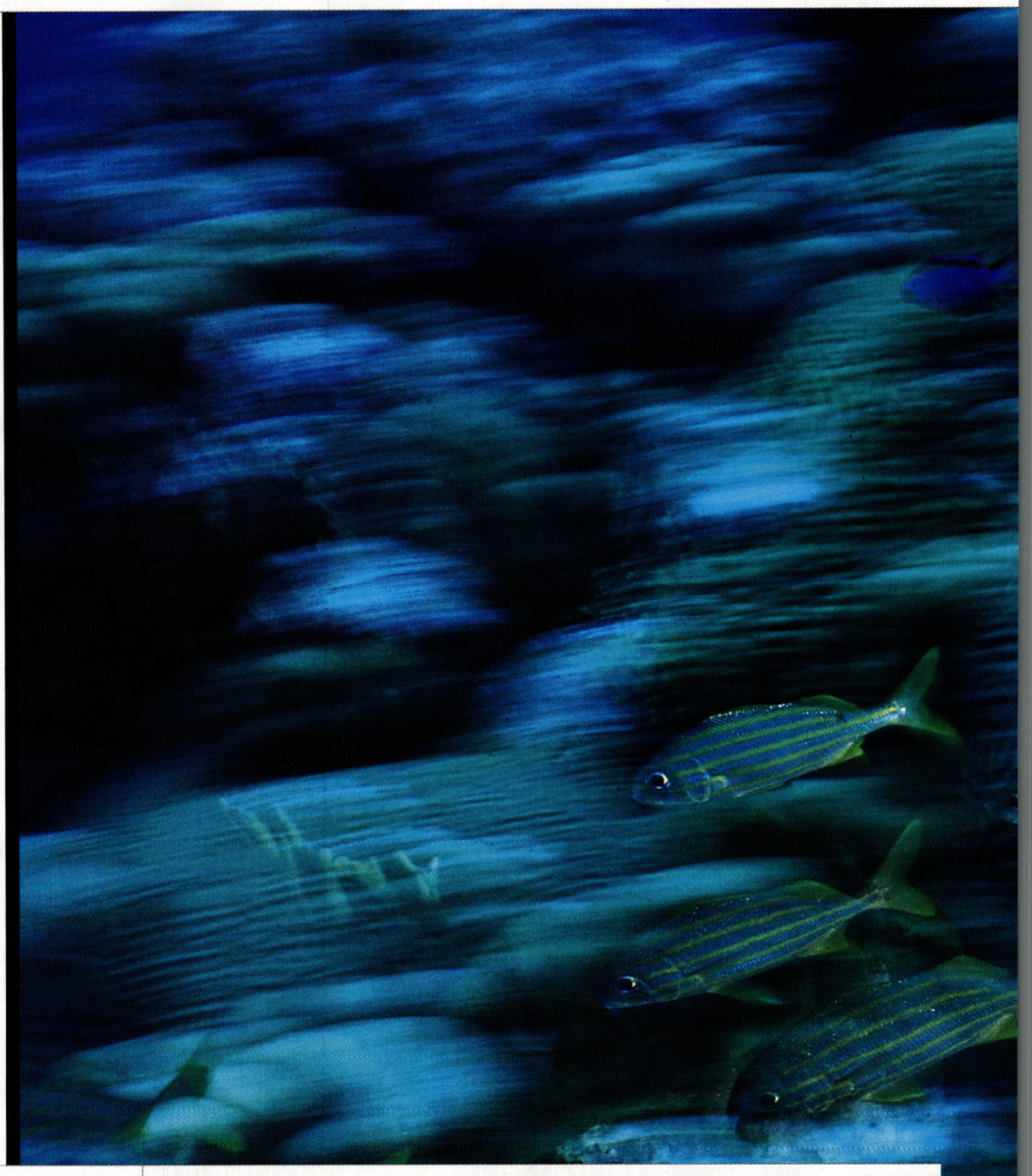


CHRIS JAFFE

DIVE GUIDE

As the Reef Turns

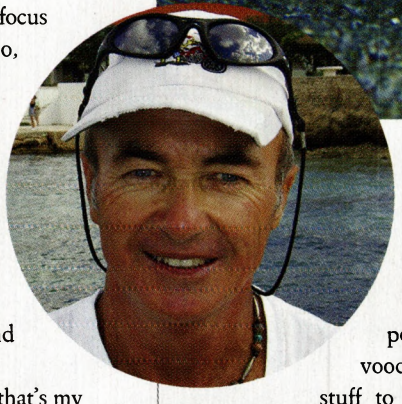
A week on Bonaire's dive sites reveals more twisted plotlines than a year of daytime television. **BY PAUL KVINTA**

"I THINK OF THE REEF HERE ON BONAIRE as one big Venezuelan soap opera," says naturalist Jerry Ligon, referring to the imported TV bodice-rippers that mesmerize the native women of this tiny Caribbean island every afternoon. "There's so much drama down there it's hard to

Cruising the reef, a school of smallmouth grunts are actors in just one of the thousands of dramatic subplots that play out on Bonaire's dive sites every day.

keep it all straight." But Jerry is attempting to do just that, sorting out for me the reef's heartthrobs and its bullies, its backstabbing, its skulduggery, its moments of sweet redemption. And its sex. Lordy, Lordy, the sex! I'm taking Jerry's "Dive with a Naturalist" course, and Bonaire's preeminent reef expert is showing me computerized fish photos and providing lurid commentary. Consider: The blueheaded wrasse mates 20 times a day. Parrotfish females can become parrotfish males. Hell hath no fury like two homeless secretary blennies battling over an abandoned worm hole. And speaking of anger, the woefully misnamed damselfish will single-handedly and ferociously defend its turf against giant mobs of marauding fish. And on and on.

When my brain can't hold anymore, we suit up on the dock overlooking Bari Reef, one of the finest stages in the world to observe marine macro dramas. For one thing, Bari has more documented fish species (317) than any other single reef in the entire Caribbean, according to the Reef Environmental Education Foundation (REEF) database. For another, Bonaire's aquarium-like diving conditions—100-foot visibility, 85-degree water, almost no current—makes it possible to focus on the theatrics at hand. Also, like most of Bonaire's 86 designated dive sites, Bari is accessible from shore. All of this adds up to a damn fine fish-watching experience, one that'll make you laugh, one that'll make you cry. And it's about as taxing as lounging on a couch and pointing a remote control.



"Now, if I pump my fist, that's my 'hot damn!' signal," Jerry explains enthusiastically, before we giant-stride off the dock. "That means I'm seeing something for the first time, or something really rare, or something just really, really cool."

The fist pump comes quickly. Five minutes into the dive a gold and white serpent side-winds across the sand, and Jerry begins celebrating. "GOLDSPOTTED EEL!" he writes on his dive slate. "VERY RARE!" For the next 60 minutes, he scribbles furiously, identifying characters, deconstructing plotlines. A longfin damsel, four inches of rage and fury, storms out from behind a pile of rocks to head-butt our pointing fingers. No one's going to poach his territory. A sharpnose puffer, the reef's resident bioterrorist, cruises by with a load of neurotoxin so potent that Haitian voodoo priests use the stuff to induce trances. A very pregnant frogfish lolls uncomfortably on an elephant ear sponge at 35 feet, her tennis ball-sized abdomen bulging with several hundred thousand eggs. We're observing her labored breathing, wondering if she'll pop at any moment, when, in a blur, two fish rocket past us toward the surface, swimming belly-to-belly and separating to form a pair of graceful arcs. "MATING PARROTFISH!" writes Jerry.

"I once saw a male parrotfish mate with seven different females in 40 seconds," he says excitedly, as we climb out of the water. "Nothing has the deck stacked against it like a fish. That's why they're reproducing all the time."

Sighting a goldspotted eel on Bari Reef sets naturalist Jerry Ligon (below) to scribbling on his slate—"VERY RARE!"

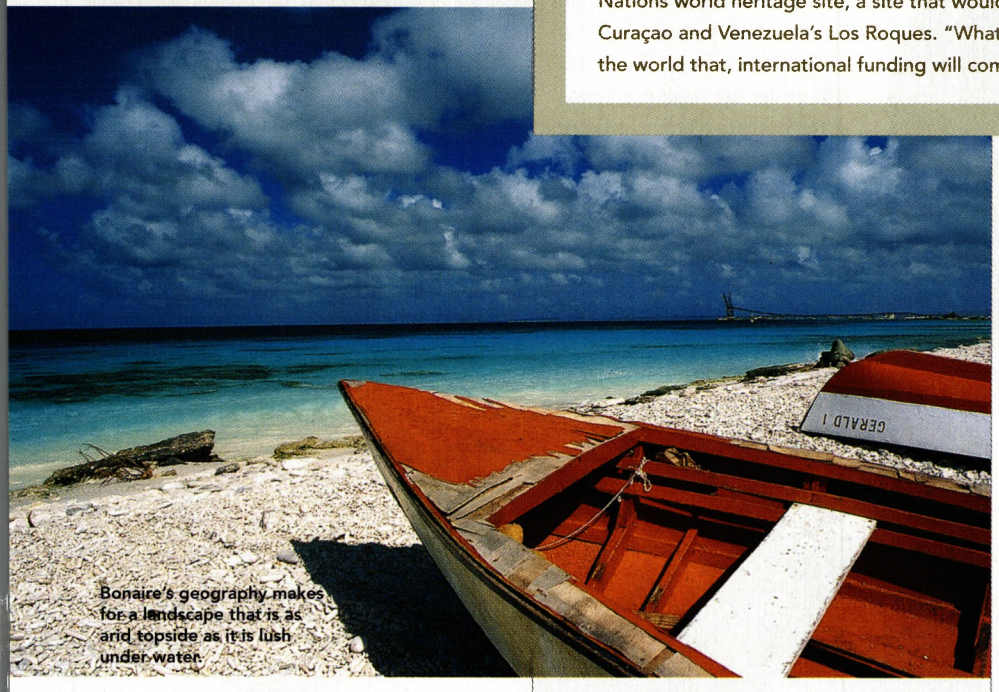
The Setting

BOOMERANG-SHAPED Bonaire has just enough candelabra cactus, exposed cliff face and wild roaming donkeys to resemble a decidedly un-tropical place—Arizona. But if the island's unique position just north of Venezuela and just south of the Caribbean's hurricane belt keeps it from receiving much rain, that same positioning also accounts for its spectacularly diverse reef life. Fish and coral embryos, during their pelagic larval stage, often float on the ocean surface for hundreds of miles before settling on a reef, and with Bonaire's trade winds and currents coming from the southeast, a wealth of genet-

STEPHEN FRINK (TOP); TIM PETERS/FISHEYE PHOTO (LEFT)

ic material regularly arrives here from South America. "A continent is giving a tiny island its pelagics," says Jerry. "It's incredible!"

He should know. For 10 years Jerry has documented the fish life on Bonaire, adopting Bari as his own personal laboratory. In 1998, he counted more than 100 species here in a single dive, an accomplishment that led him to form the "Century Club" for equally accomplished fish geeks. He's taught dozens of divers how to conduct fish surveys for REEF. With a toothy grin and twinkly blue eyes, the 60-year-old former biology teacher from Colorado has a certain gung-ho energy for the task that's infectious, one that's mirrored only by his other passion, birding. "Counting fish is a lot harder than counting birds," he insists. "Never, never, never does a bird change colors in five seconds. Fish do."



Bonaire's geography makes for a landscape that is as arid topside as it is lush underwater.

CHRIS JAFFE

On an island like Bonaire, where the mantra is "shore diving," taking Jerry's naturalist course and absorbing the details is particularly useful. With boat diving, a knowledgeable divemaster can be helpful in determining a cherub from a flameback angel. But here, with easily accessible walk-in sites all along the west coast, divers cherish autonomy, and the standard routine is to rent a vehicle with your buddy, load it up with tanks and look for the bright yellow stones on the side of the road with the names of reefs printed across them.

Armed with Jerry's fish facts, though, my tour of Bonaire's reefs suddenly seems more dramatic. At Calabas Reef, for example, a billowy, white corkscrew anemone withdraws as I inch near, and when an enraged pistol shrimp comes charging out from among the tentacles, waving its oversized claw like a battle-ax, I know why. In exchange for a comfy place to sleep, the shrimp guards the anemone like a Doberman pinscher, and if I don't remove my index finger soon, this little guy's going to swipe me with his claw. Farther up the coast, meanwhile, at a reef called Andrea II, I watch a single black damsel square off with a mob of blue tangs, wrasses, parrotfish and trumpetfish. Damsels control the food-rich reef bottoms, and, aware of their tenaciousness, other species swoop in with superior numbers. This damsel is defending a sweet piece of real estate bordered by a large brain coral and a cluster of lavender stovepipe sponges. But as he jabs at individual invaders, other fish drop down and scoop up tasty morsels. Alas, it's a losing battle for the damsel. He's overwhelmed.

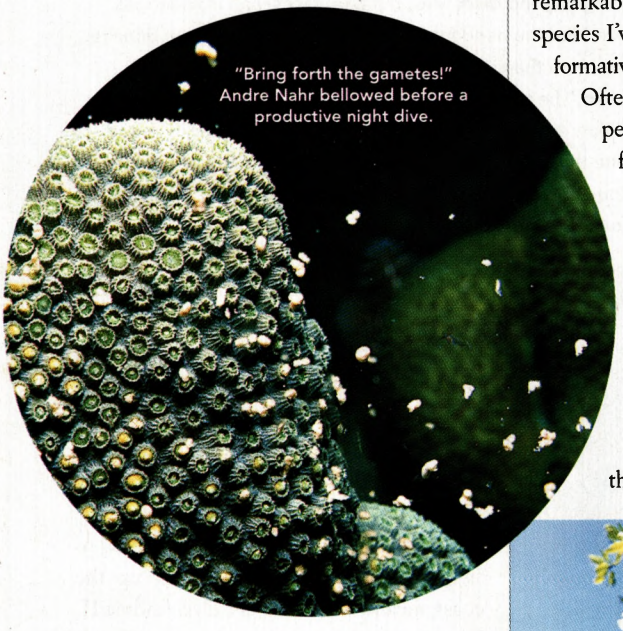
There's one drama in particular I'd really like to see, although Jerry tells me not to get my hopes up. "Not many divers ever see a coral spawning," he admits. "We still don't know that much about the process." All of Bonaire's dive sites feature a flamboyant assortment of hard corals—maze and brain,

WHERE DIVERS ARE PARK RANGERS

A MODEL FOR CARIBBEAN underwater conservation, Bonaire National Marine Park immediately incorporates visiting divers into the process. When I check into Divi Flamingo, dive manager Serge De Groote promptly collects a $10 park fee from me, lectures me on park regulations and has me execute a park-mandated checkout dive. Like that, the park not only has my money, it has a diver aware of the island's strict conservation ethic. "The best thing we have on Bonaire are concerned divers," says park manager Maarten Schuit. "Divers become our eyes out on the reef." They certainly do. In October, officials arrested a man for spearfishing within park boundaries after divers reported his transgressions.

Still, without significant funding beyond diver fees, the park faces major challenges, like creeping coastal development and the need for a sewage treatment plant on Bonaire. Schuit also wouldn't mind having more than six rangers to patrol the island-wide park. "Every written rule is being broken," he laments. But help could be on the way. Bonaire is now campaigning with its neighbors to secure the world's first "trans-boundary" United Nations world heritage site, a site that would include the underwater bounty of Bonaire, Curaçao and Venezuela's Los Roques. "What we have is special," says Schuit. "If we tell the world that, international funding will come."

staghorn and elkhorn, finger and pencil, mustard hill and lettuce. Of the island's 50 or 60 species, Jerry has seen three do the deed—boulder star, giant star and smooth flower. Apparently, it's quite a spectacle, a dazzling moment when the reef suddenly bursts forth with eggs, sperm and embryos, clouding the water with the fundamental essence of life itself.



"Bring forth the gametes!" Andre Nahr bellowed before a productive night dive.

The major spawn for these species occurs in September, with a minor spawn one month before and one month after. It's October. I still have a shot. But the event is shrouded in mystery. It occurs only at night, and as well as scientists can tell, it happens five to seven days after the full moon. It's day four. I must wait.

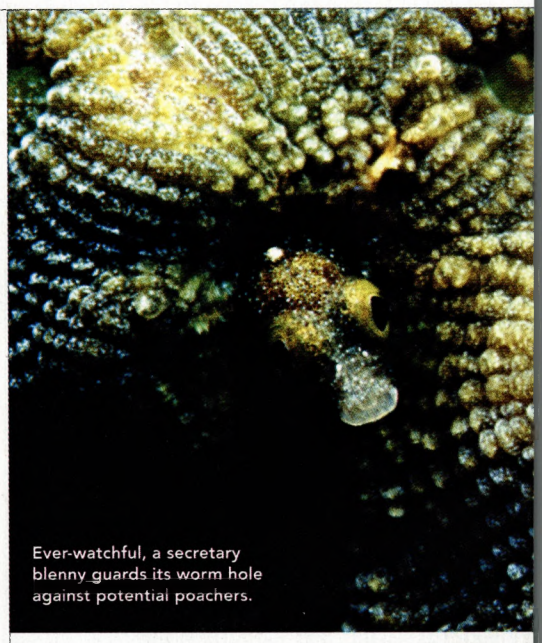
The Nursery

WE POP OUR KAYAKS out of a dark tunnel and glide into a serene clearing, where tricolored herons poke about the shallows and frigate birds circle overhead. We're deep inside the mangrove forest on Bonaire's windward side, and beneath us in two feet of gin-clear water, fish scatter over the sandy bottom—surgeons, butterflies, parrots and trunkfish, juveniles mostly. "This is where the fish develop before they go out to the reef," explains Gerard van Erp, owner of the Mangrove Info and Kayak Center. "The seagrass beds here are full of rays and seahorses. Turtles eat the grass to harden their shells."

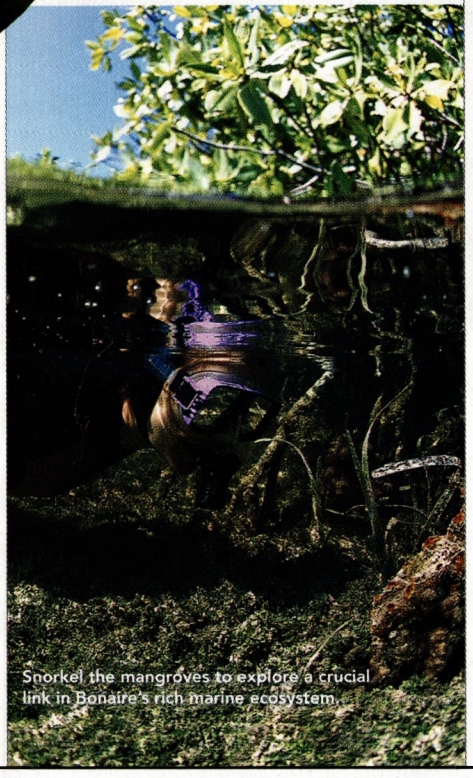
Indeed, this dense wetland forest lining Lac Bay is another secret to Bonaire's remarkable fish diversity. Many of the species I've seen out on the reef spend their formative periods in this sheltered nursery.

Often viewed as useless swamps, 50 percent of the world's mangrove forests have been cleared in the last 15 years, but fortunately, that won't happen here. This area falls under the strict protection of the Bonaire National Marine Park, an entity that encompasses the island's entire coastline, as well as that of its satellite island, Klein Bonaire.

For two hours, we poke about the inlets and coves here. At one stop, we stare at a bunch of portobello-sized discs lying in the sand under our boats. "Upside-down jellyfish," notes van Erp. "A fine example of symbiosis." The jelly does this periodically to provide sunlight for its resident algae, a critter that makes sugar for the fish via photosynthesis. Later, we snorkel through a narrow, 100-foot-long tunnel through the mangroves, and in the tangled root systems on either side of us, we marvel at dazzling sponges—yellow, red, blue and purple— brilliantly lit by the late afternoon sun. They are as colorful as anything out on the reef.



Ever-watchful, a secretary blenny guards its worm hole against potential poachers.



Snorkel the mangroves to explore a crucial link in Bonaire's rich marine ecosystem.

The Orgy

ON THE SIXTH NIGHT after the full moon, Andre Nahr, owner of Bonaire Dive & Adventure, steps to the edge of the dock and gazes out over Bari Reef. "Oh great gods of the sea!" he bellows, stopping briefly to giggle. "Bring forth the gametes! Bring forth the eggs and sperm from these wondrous coral! Let them be fruitful! Let them ... come on Jerry, you've got to help with the incantation. How can you expect a coral spawning without the incantation?"

"I didn't know this was a faith-based dive," I say, pulling on my wetsuit.

"It's not," grumbles Jerry. "It's based on the calendar. It's based on science." Jerry's in

TOM STACK (TOP LEFT); MARLI WAKELING (TOP); CHRIS JAFFE (LEFT); ETHAN GORDON (RIGHT)

Like a soap-opera villain hiding in the shadows, a longlure frogfish lies in wait for unsuspecting prey.

an unusually foul mood. Not only did he injure his shoulder hoisting tanks for Nahr earlier today, but a friend of his saw no evidence of the spawn last night. He doubts our prospects this evening. To complicate matters, we're diving with a woman named Betty who's toting a cumbersome video rig with a pair of huge, high-intensity lights. She's promised not to activate the powerful beams until Jerry gives the signal, for fear of possibly impacting the spawn. "Let's go," he mumbles.

For 15 minutes we canvass the reef, carefully examining coral heads with our handheld lights. Nothing. We succeed only in attracting monster tarpon, interested in any unfortunate groupers we might inadvertently spotlight.

Finally, there's an unexpected metal tapping. I swim over and find Jerry hovering at 35 feet, the word "SPERM!" dashed across his dive slate. He is absolutely giddy. Before him, a giant star coral is smoldering, a smoke-like substance swirling out of every polyp and slowly drifting toward the surface. We move in for closer examination, when suddenly, Betty's high beams flash on like a pair of blinding headlights, shamelessly exposing the ejaculating coral head for the entire reef to see. I feel like a cop who has just busted a pair of backseat lovers.

But spawning is breaking out all over. We come across a boulder star coral spewing what appear to be millions of tiny pencil erasers. After that, we watch a smooth flower coral emitting scores of pinhead-sized white dots. Jerry can't squeeze it all onto his slate, but we've been well-briefed. The pencil erasers are packets of eggs wrapped in gelatinous sperm. Unlike the giant star, whose gender-specific coral heads produce either sperm or eggs, the boulder star produces both. The white dots of the smooth flower, meanwhile, are fully formed embryos created within the coral head. Once fertilized, all of this genetic material, regardless of its form, will wander the open ocean indefinitely before settling onto a substrate somewhere and pioneering new coral beauty.

"Hot damn!" yells Jerry, as we surface. "*Montastraea cavernosa, Montastraea annularis* and *Eusmilia fastigiata*! All three species in one night! That's never been seen on Bari Reef! Never!"

Not only that, the spawning seems to have mysterious curative power. I ask Jerry about his aching shoulder. "Feels great!" he exclaims. "Not a problem. Hey, that was some show, huh?" SD

GET THERE > For more information on Bonaire, turn to In Depth, page 100, section 5.

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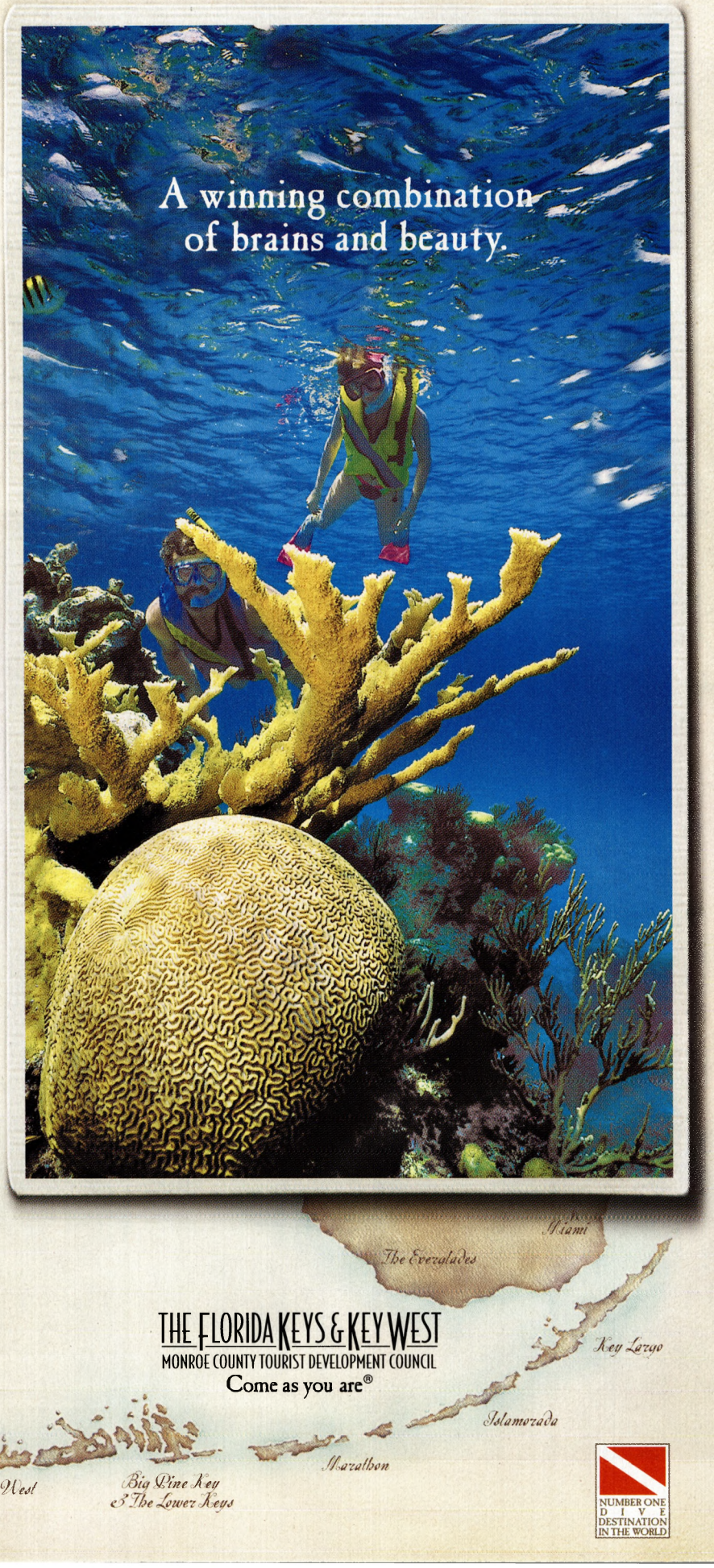


Legend has it that early explorers named this grotto Devil's Den because the water steamed like a witch's cauldron on winter mornings.

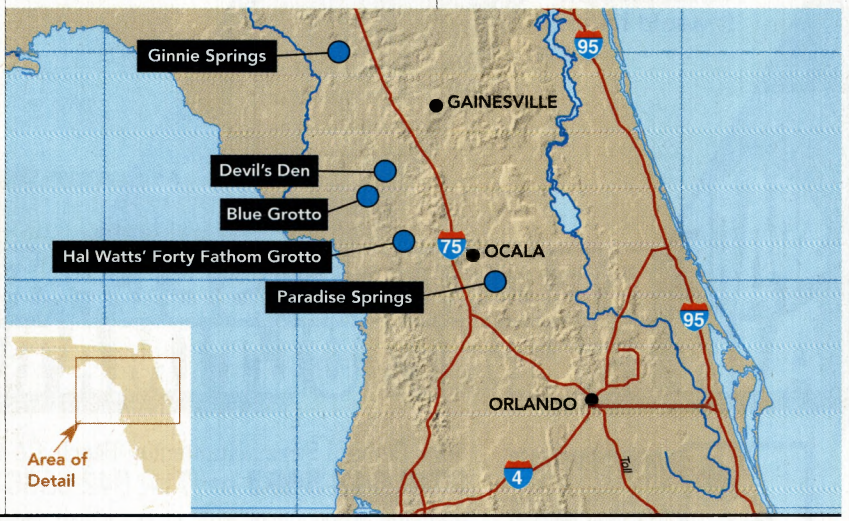
Great Spring Diving

Hit the road, Jack, and don't you come back until you've seen these freshwater beauties. **BY BUCKY MCMAHON**

I STOWED MY dive gear in the back of the truck and headed east for the backwoods of North Central Florida. Here in the heart of what natives like to call "the real Florida," you're never far from a dozen or so of the best freshwater dives in the state, if not the world. I had a packet of salted cashews to toss at my piehole; I had Lucinda Williams singing "Car Wheels on a Gravel Road" in the tape player; I had two days to dawdle and dive. It was a win-win-win situation.

That's because neither heat, nor cold, nor rain can much mar a Florida spring dive. The year-round 72-degree water temp is like a rich man's thermostat: set thrillingly chilly on a hot day, toasty warm in sweater weather. And the vis often defies measurement, seeming somehow sharper than air, hyper-real, as if you're wearing 3-D glasses in your mask.

The water even tastes good, though you don't have to swallow any to receive the refreshing effect of these limestone fountains of youth. You always finish a spring dive feeling exhilarated, especially if you've been prowling around in the dark cavern zone, spooking yourself by shining your dive light into forbidding caves. "Turn back!" as the Grim Reaper signs advise. This isn't just the better part of valor, but the best part of diving in freshwater springs: The homeward-bound view, seen as if through the wrong end of a telescope, of the great blue eye of the sky.



PHOTOGRAPHY BY **TIM O'KEEFE**

Ginnie Springs

THE FIRST LADY OF FRESH WATER > I drove out of the trees and into the little town of High Springs, home of the Great Outdoors Café (great eats cheap) and Extreme Exposure dive shop where I stopped in for a chat. "You going to Ginnie? Take a right at the Texaco, seven-point-two miles watch for the sign," they said.

They get asked a lot, since Ginnie Springs is one of the most popular commercial dive sites in Florida. There are several named springs on the wooded grounds beside the Santa Fe River, but the star attraction is the wide spring basin, Ginnie itself. This exquisite shallow bowl of bubbling limestone and lush aquatic grasses is roomy enough to accommodate canoeists and snorkelers, while divers cavort unseen in the cavern (which explains the perpetually percolating bubbles). Surprisingly roomy, the Ginnie cavern is also the most benign overhead space I've ever dived. The wide, arched entryway is quite shallow, at about 15 feet, and then slopes gradually to a depth of 45 feet, where an iron grate bars the way to the cave zone.

The sprawling Ginnie Springs complex includes the spring run to the Santa Fe River and campgrounds.

The bottom, of limestone boulders, rubble and sand, is well-nigh silt-proof for bottom bouncers, though I highly recommend gently fin-walking on the cavern roof, a technique I learned at a cavern class I took there. For all its

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friendliness, it's still plenty dark in the back of the room, where stone-cold catfish glare back at you, daring you to try some tight swim-throughs. When the flow is cranking, try this: Hold onto the iron bars and feel the mask-flattening force of the aquifer. Then let go and soar out on pure spring power—the Ginnie Springs signature move.

Also worthy of a dip are Devil's Ear and Devil's Eye, the former a crack in the earth and the latter a classic crater—both catering to the tastes of claustrophiliacs. The two springs are connected by a first-rate cave dive, but open-water divers are permitted to sample the drop straight down into the rock as long as they stay within ambient light.

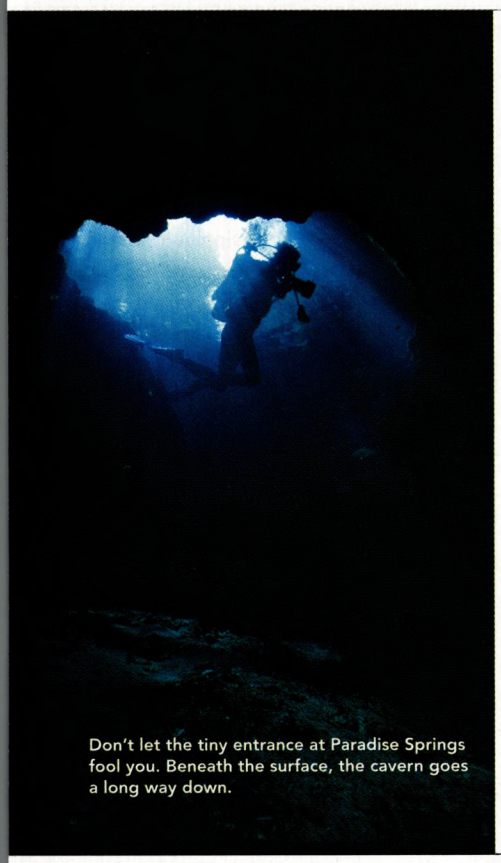
The spring run containing the Ear and the Eye is a relaxing, scenic kick. Keep cruising past the Eye to the edge of the Santa Fe River, where the boutique bottle-worthy spring water mingles with the dark river to weird effect. Like a thermocline, the borderline goes all wavery like jet exhaust. Cruise along half in and half out—all brightness and light on one side, the other all gloomy and sepia-toned like a photo from the '30s—and you're in two worlds at once.

Devil's Den and Blue Grotto

COME ON DOWN, Y'ALL, THE WATER'S WARM > The biggest events in the history of Williston, Fla., were literally earth-shaking. Beneath the landscape of gently rolling hills and drooping live oaks festooned with Spanish moss, lies a porous limestone bedrock. Back when prehistoric horses the size of dachshunds and giant sloths (perhaps the same two I saw selling boiled peanuts beside the highway?) roamed the area, the earth caved in, creating a number of surprising holes in the ground. Two of the prettiest—Devil's Den and Blue Grotto—happen to be near neighbors.

Topside, Devil's Den gets the nod as Florida's comeliest sink. It's a true subterranean grotto, with sunshine shafting in through a natural skylight from which

Although it's only 100 feet deep, divers swear Blue Grotto has 200 feet of visibility.



Don't let the tiny entrance at Paradise Springs fool you. Beneath the surface, the cavern goes a long way down.

dangle filigree strands of leafy vines. Entrance is through a gap in the stone, down a long wooden stairway to a dock where a greeting committee of hefty catfish awaits, roiling the surface.

The dive is a classic sinkhole roundabout, circling the debris cone where the roof caved in, with lots of swim-throughs among the boulders down at about 65 feet where the cavern walls out. There are several cave entrances along the walls, some too large to be closed by grilles—but definitely not silt-proof, nor to be trifled with—evoking the somber ambience of catacombs, and lots of fossils in the rock. Or so we were told in the dive shop. My buddy Kurt, a dive instructor from Ohio, and I couldn't find them. Instead, Kurt tugged on my wetsuit sleeve and, eyes bugging behind his mask, pointed out a catfish as big as a one-man sub. Not the devil, maybe, but this was surely his den.

About a mile up the highway, and down a narrow dirt road, Blue Grotto wins the award for diver access. With gaping open-water pools and generous cavern zones, the sink also gets my vote as best-endowed down below. The brochure says it's 100 feet deep, and boasts of 200-foot-plus vis. What I wonder is, how do they know? But the divers I greeted coming up were all grins and superlatives. Who was I to argue?

Paradise Springs

NEXT STOP: MIDDLE EARTH > I even liked the directions: Follow the divided highway until it comes together, and then turn back at your first U-turn. You just knew Paradise had to be remote, and it was. I found the little dive

shop deserted, so I moseyed back around to the farmhouse where the proprietor, a young woman with a baby and a dog, said she'd be along directly to sign me in. You can't get into Paradise alone, so I buddied up with Steve and Mike—two more Ohioans, as it happened.

Paradise is a pretty little sink, shaded by oaks and surrounded by lush tropical vegetation. But don't be fooled by the diminutive surface—it goes a long way down, a narrowing funnel into Middle Earth. The old Grim Reaper greets you at the end of the yellow guideline at 99 feet, and that's about as far down as any sane person would care to go. With 15 feet of turnaround space, it's not exactly a squeeze, but it felt plenty tight enough. We turned around and headed for the blue dot, and finished the dive circling the debris cone and admiring fossilized sand dollars many millions of years old on the cavern ceiling.

Hal Watts' Forty Fathom Grotto

FLORIDA'S GREATEST VOID >

There's a lot of history in the Forty Fathom Grotto, not to mention at least 10 old cars, including a classic '65 Corvette at 105 feet. This former aquatic junkyard turned state-of-the-art technical dive training facility is full of interesting stuff (a boat, a sub, whatever sinks). The only thing it seems to lack is a bottom. Owing to the sink's vast dimensions, and the duckweed on the surface dimming the deep environs, diving is with certified guides only. You won't regret the extra expense though once you start exploring its man-made oddities—like a motorcycle suspended by rope at 40 feet—and natural wonders—its fossil sea cucumbers and maze-like caverns.

I stuck close to guide Dan Patterson as we made a 30-minute circuit of Florida's greatest void, and he made sure I didn't miss anything, or take any wrong turns in the maze of caverns.

At 70 degrees, the Forty Fathom Grotto is slightly cooler than most Florida sinks, and by the end of the circuit I felt a slight chill even with my 3mm wetsuit—though I couldn't tell if this was physical or metaphysical. Afterward, clambering up the 39 steps to sea level, I felt a joyful tingle, feeling that once again I had dodged, well, maybe not death, but depth. SD

GET THERE > For information about diving Florida's springs, turn to In Depth page 100, section 4.

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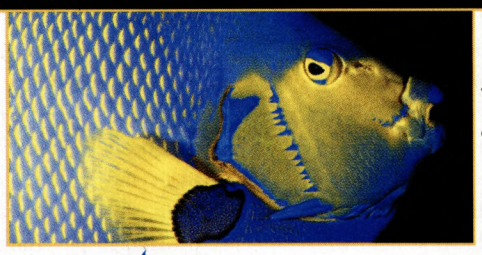
Photo by Doug Richardson

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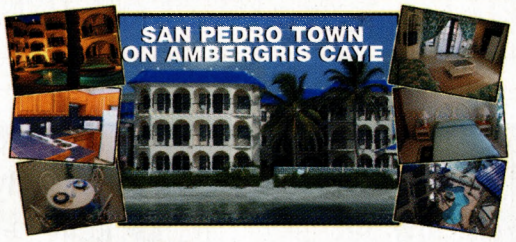

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PUERTO RICO

Scuba Diving Photo Expedition

1 THE DEAL: Join photographers Georgienne Bradley and Jay Ireland for a week of photo tips while diving and sightseeing for $829 p.p. Bradley and Ireland will be on assignment for *Scuba Diving*, and you'll accompany them as the story unfolds. The event is May 8-15, 2004, and includes seven nights, five days of two-tank dives, accommodations at Copamarina Beach Resort, mangrove tour and snorkel, and hikes in the Guanica Dry Forest. *(800-301-1467)*

ROATAN, BAY ISLANDS

More Than Half Off

2 THE DEAL: Fantasy Island Resort offers divers an eight-day, seven-night *Scuba Diving* special for $402 p.p., dbl. occ., plus taxes, compared to the regular price of $820. Special is good through Feb. 1, 2004, and includes airport transfers, welcome drink, three dives per day, night dive and unlimited shore diving, three meals per day, use of kayaks, and tanks and weights. *(866-726-9588, www.fantasyislandresort.com)*

GRAND CAYMAN

Group Discount Package

3 THE DEAL: Red Sail Sports teams up with Indies Suites to offer a package for dive groups. The special runs Jan. 15-Dec. 1, 2004, with rates starting at $118 p.p., per night, quad. occ., for a seven-night stay. This includes deluxe accommodations in a 975-square-foot suite, daily two-tank dives, continental breakfast daily, afternoon boat dive, sunset sail, barbecue night and discounts off watersports. *(877-RED-SAIL, www.redsail-cayman.com, www.indiessuites.com)*

In May, join photographers Georgienne Bradley and Jay Ireland at Copamarina Beach Resort on the southwest coast of Puerto Rico.

STEPHEN FRINK

LITTLE CAYMAN

15% off or Two Divers Go Free with Group

4 THE DEAL: Paradise Villas invites divers to take advantage of its group rates. Mention *Scuba Diving* and two divers go free with six paid divers; three divers go free with nine paid divers. Paradise Villas also offers *Scuba Diving* readers 15 percent off. The special runs until April 30, 2004. Call for availability and pricing. *(877-3-CAYMAN, www.paradisevillas.com)*

MALAYSIA

Seventh Night Free

5 THE DEAL: Borneo Divers offers a new package where the seventh night of lodging is free. The special is valid at either Sipadan Island Resort or Mabul Island Resort and applies for travel through Dec. 15, 2004. Prices begin at $999 p.p. at Sipadan Island or $630 p.p. at Mabul Island, including round-trip transfers from Tawau, hotel taxes, all meals, nonalcoholic beverages, three daily boat dives, plus unlimited shore diving at Sipadan. Airfare is not included. Groups with 11 paid divers get the 12th diver free. *(800-346-6116, ken@divetrip.com)*

BELIZE

Jacks, Jungles and Jaguars

6 THE DEAL: To celebrate 16 years of diving Belize's outer reefs, Aggressor Fleet offers the chance to explore the walls of Turneffe Islands and Lighthouse Reef trip on the *Belize Aggressor III* for $200 off the standard rate. From Jan. 3 to March 13, 2004, prices are $1,895 p.p., dbl.

Pirate's Lady, Sea Explorer, and Morning Star sail the crystal waters of the Bahamas on weekly dive/cruise adventures.

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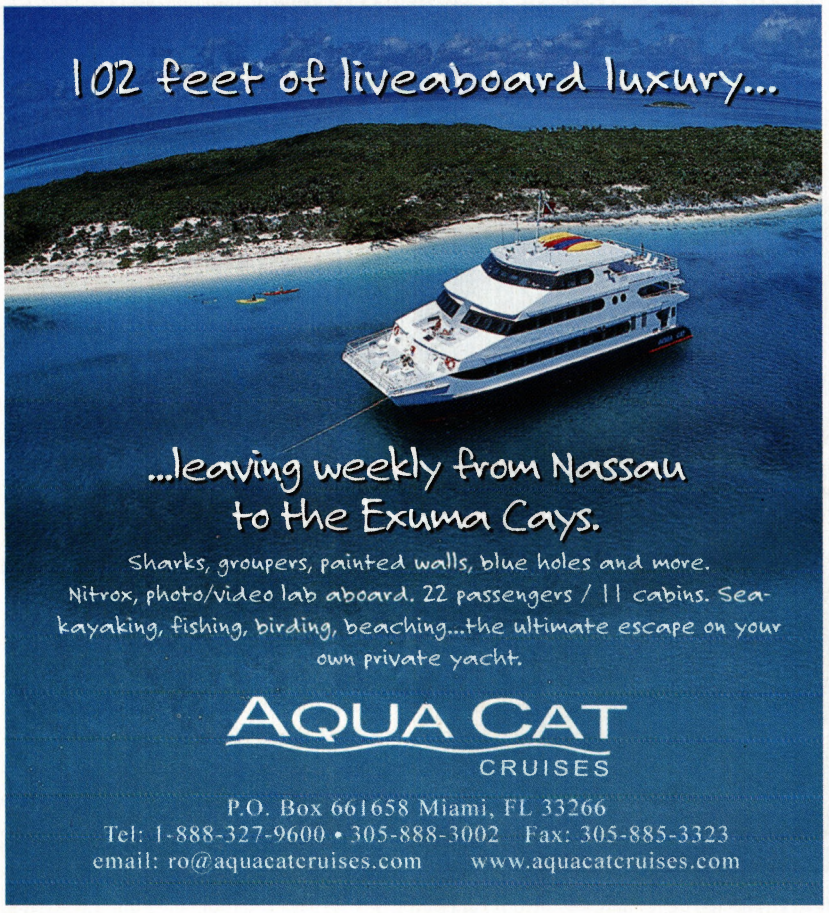


occ., for a weeklong trip with five-and-a-half days of diving. Airport transfers are included. The special rate does not apply to groups. *(800-348-2628, www.aggressor.com)*

BONAIRE

'3-D' Drive, Dive Deluxe Package

THE DEAL: This package from Plaza Resort is $768 p.p., quad. occ., including an air-conditioned, two-bedroom villa with a kitchen, a double-cab pickup truck and unlimited shore diving. Valid Jan. 3-April 15, 2004. Upgrades for daily boat dives with Toucan Diving are available. Airfare is not included. *(011-599-717-2500, www.plazaresortbonaire.com)*

RIVIERA MAYA, MEXICO

Free Kids' Activity

THE DEAL: Receive one free PADI Discover Scuba Diving or Bubblemaker experience program, usually $75, for children 15 and under with purchase of a dive and accommodation package from Dive Aventuras for two adults. The package includes five days, four nights, four ocean dives and one cenote dive for $599. Some restrictions apply. *(dive@diveaventuras.com, www.diveaventuras.com)*

UTILA, HONDURAS

$50 off by Feb. 1

THE DEAL: Package includes six days, seven nights' accommodations in Mango Inn's new penthouse cabins, three boat dives per day with Utila Dive Centre, all equipment, breakfast and dinner daily, round-trip airport transfers, welcome cocktail, and all taxes and service charges. Price is $699 p.p., dbl. occ., and is valid for travel until Dec. 15, 2004. Airfare is not included. Book with Aqua Dreams Travel by Feb. 1,

2004, and get $50 off p.p. *(888-322-3483, www.aquadreams.com)*

PAPUA NEW GUINEA

$999 Special

10 **THE DEAL:** Peter Hughes' *Star Dancer* offers divers a seven-night, 20-percent-off special in January, February and March 2004. The first person pays $1,516 and the second person pays only $999. The rate for a single person is $1,257.50. *(800-932-6237, www.peterhughes.com)*

COZUMEL

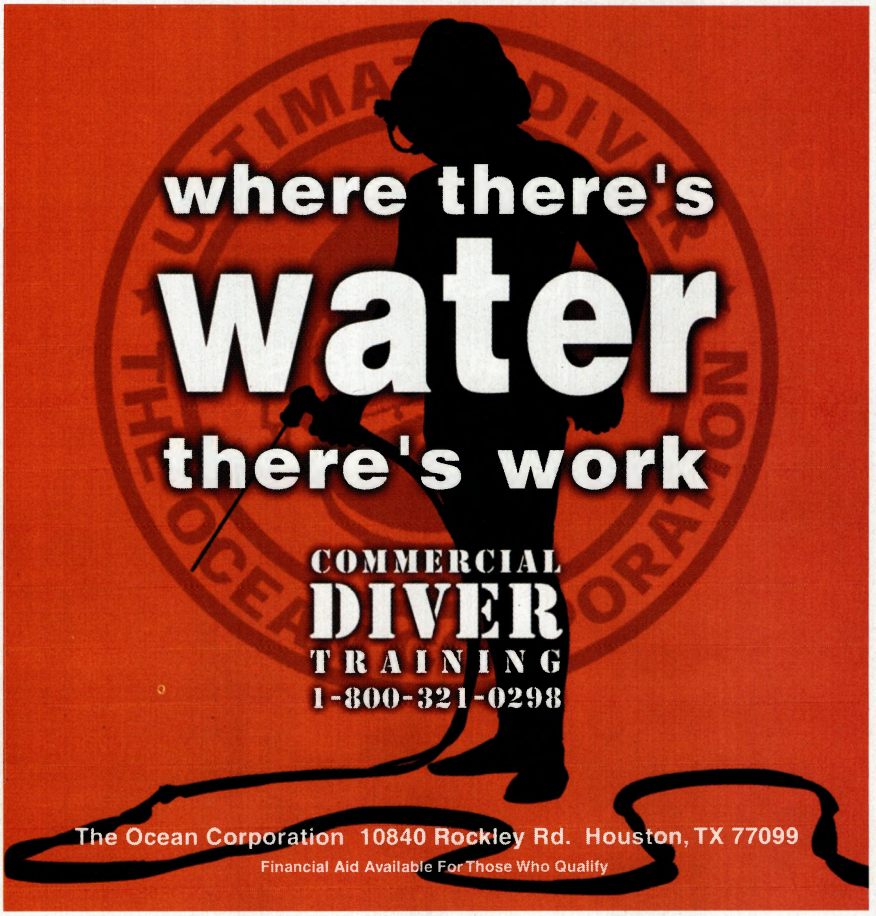
2004 Discount

11 **THE DEAL:** From Jan. 4 to Sept. 1, 2004, El Cid La Ceiba Beach Hotel offers three nights, two days of boat diving with Dive With Martin for $299 p.p.; five nights, three days of boat diving for $528 p.p.; and seven nights, five days of boat diving for $649 p.p. Prices include lodging, daily buffet breakfast, two tanks per day, unlimited shore diving, welcome drink, beer bucket and chips, and taxes. *(800-897-5553, www.elcid.com, www.divewithmartin.com)*

CAYMAN BRAC

Family Week

12 **THE DEAL:** The second annual family week on Cayman Brac is July 11-18, 2004. Kids can participate in Supplied Air Snorkeling for Youth (SASY) or Bubblemaker. New activities include day trips to Little Cayman and cruises around Cayman Brac. Prices are $859 p.p., dbl. occ., for adults and $359 p.p. for children under 12, including airfare from Miami, seven nights' accommodations at the Brac Caribbean Beach Village or Carib Sands Beach Resort, a Family Week pass, hotel transfers and hotel taxes. *(866-THE-BRAC, www.866thebrac.com)* SD



top 100 Readers' Choice Awards

Here they are: The top of the heap, the cream of the crop, the world's best dive destinations today, as determined by the world's most discriminating critics: our readers.

PHOTOGRAPH BY TANYA BURNETT & KEVIN PALMER

Readers found perfection in Papua New Guinea, which they rewarded with a perfect score for overall diving.

top dive destinations

Top Dive Destinations

If you spent the rest of your life doing nothing but exploring the subaquatic offerings of the destinations on this list, you could die a happy diver. In fact, you could limit yourself just to the top destination in each of our three regions—Bonaire, Papua New Guinea and British Columbia—and still be doing alright. Last year, we were surprised to see British Columbia score a perfect 100, but you can't catch us off-guard twice. By now, we expect to see high marks from dry-suited divers enjoying overgrown gardens of anemones alongside sea lions, orcas and wolf eels. On the other side of the Pacific Ocean, readers found equal perfection on the pristine reefs of Papua New Guinea, which claimed the top spot over last year's Pacific winner, the Galapagos Islands. And in the Caribbean/Atlantic region, 24-hour access to the world's best shore sites earned Bonaire the No. 1 rating yet again. As one reader wrote, "Beautiful, easy diving with great diversity, consistently good visibility and great weather. I can't say there's anything about Bonaire I didn't like."

CARIBBEAN/ATLANTIC

1.	Bonaire	95.2
2.	Cozumel, Mexico	93.2
3.	Grand Cayman	91.1
4.	Bimini, Bahamas	91
5.	Little Cayman and Cayman Brac	90.9
6.	Saba	89.7
7.	U.S. Virgin Islands	89.2
8.	Belize Atolls	86
9.	Grand Turk and Salt Cay, Turks & Caicos	84.6
10.	Exumas, Bahamas	83.3
11.	Providenciales, Turks & Caicos	83.1
12.	Roatan, Bay Islands, Honduras	82
13.	Curaçao	81.3
14.	Cay Sal Bank, Bahamas	80
15.	Utila, Bay Islands, Honduras	76.2
16.	Riviera Maya, Mexico	76.1
17.	Ambergris Caye, Belize	75.9
18.	New Providence, Bahamas	75
19.	British Virgin Islands	73
20.	Puerto Rico	68.2

PACIFIC AND INDIAN OCEAN

1.	Papua New Guinea	100
2.	Truk, Micronesia	98.2
3.	Palau, Micronesia	97.1
4.	French Polynesia	96.2
	(tie) Yap, Micronesia	96.2
6.	Egyptian Red Sea	95.8
7.	Galapagos Islands	92.1
8.	Big Island, Hawaii	90.7
9.	Thailand	88.9
10.	Indonesia	87.9

NORTH AMERICA

1.	British Columbia	100
2.	Channel Islands, Calif.	92.9
3.	North Carolina	91.8
4.	Flower Garden Banks, Gulf of Mexico	90.2
5.	Southeast Florida*	89.1
6.	Islamorada and Tavernier, Florida Keys	86
7.	Key Largo, Florida Keys	79.5
8.	Washington State	73.1
9.	Key West, Florida Keys	65
10.	Marathon, Florida Keys	64.7

* Broward, Dade and Palm Beach counties.

MARLI WAKELING (LEFT); JULIE MORGAN / SEAPICS.COM (RIGHT)

Little island with big scores: Readers say Bonaire offers the best diving in the Caribbean/Atlantic region. Left: When you visit British Columbia, take a hood, take a light and prepare to be wowed.

top value

Dive paradise and save: Utila is one of the world's most affordable destinations.

Top Value

Value, of course, is in the eye of the credit-card holder—what seems to be a great travel bargain to one globe-trotting diver may decimate the life savings of another. But our thrifty readers are pretty good at spotting a deal when they see one, as evidenced by the excellent value ratings for destinations like Utila and Cozumel. Thanks to affordable accommodations and cheap eats, funky Utila in Honduras's Bay Islands is popular among backpackers and other budget travelers. Fortunately for divers, it's also popular among whale sharks. Big animals are also the draw at the top-rated value destination in the Pacific region. In the channels between the open ocean and Yap's shallow lagoon, divers swim with the giant manta rays that come like clockwork to feed there. And an encounter like that is a bargain at any price.

CARIBBEAN/ATLANTIC

1.	Utila, Bay Islands, Honduras	92.7
2.	Cozumel, Mexico	88
3.	Bonaire	86.8
4.	Saba	85.7
5.	Roatan, Bay Islands, Honduras	85.4

PACIFIC AND INDIAN OCEAN

1.	Yap, Micronesia	96.2
2.	Thailand	94.4
3.	Truk, Micronesia	92.6
4.	Egyptian Red Sea	91.7
5.	Papua New Guinea	90.9

NORTH AMERICA

1.	British Columbia	96.3
2.	Flower Garden Banks, Gulf of Mexico	95.1
3.	Southeast Florida	89
4.	Islamorada and Tavernier, Florida Keys	84.7
5.	North Carolina	81.7

RICK FREHSEE

top marine life

The parade of fish in Papua New Guinea entrances one of its own, a leaf scorpionfish.

STUART & MICHELE WESTMORLAND

Top MarineLife

In many divers' minds, there's a direct correlation between the amount of marine life at a destination and the quality of that destination's diving. That would explain why the three destinations rated best overall in their respective regions—Bonaire, Papua New Guinea and British Columbia—also came out on top in this category. As different as they are, each of these places is known for the abundance of life in its waters, from the wild and enormous schools of fish in PNG to the lushly carpeted rock reefs of British Columbia, to the aquarium-like waters of Bonaire, where every living creature is protected by the island's pioneering marine park.

CARIBBEAN/ATLANTIC

1.	Bonaire	93.9
2.	Grand Turk and Salt Cay, Turks & Caicos	88.6
3.	Cay Sal Bank, Bahamas	88.5
4.	U.S. Virgin Islands	87.3
5.	Cozumel, Mexico	87

PACIFIC AND INDIAN OCEAN

1.	Papua New Guinea	100
2.	Palau, Micronesia	98.1
3.	Yap, Micronesia	96.3
4.	Egyptian Red Sea	95.8
5.	French Polynesia	92.3

NORTH AMERICA

1.	British Columbia	100
2.	Channel Islands, Calif.	93.3
3.	Southeast Florida	88.6
4.	Flower Garden Banks, Gulf of Mexico	86.3
5.	Islamorada and Tavernier, Florida Keys	85.7

10 visibility

Top Visibility

For the hordes of divers who make their checkout dives in the mudholes, sinks and quarries closest to their local dive shops, that first dip in transparent ocean waters can be a life-changing experience. To relive the rush that comes from being able to see well past the tips of your fins, kick over the reefs of Bonaire and Papua New Guinea, or let the current carry you over the famed sites of Cozumel. The massive walls of the Cayman Islands are all the more impressive because you can take in their grandeur at a glance. And the same goes for the sharks of French Polynesia, the convoluted lava formations of Hawaii's Kona Coast and reefs of the Flower Garden Banks. When you get right down to it, the reasons to travel to these destinations are perfectly clear.

On a clear day, you can see forever. And on Bonaire's reefs, every day is a clear day.

STEPHEN FRINK

CARIBBEAN/ATLANTIC

1.	Bonaire	94.3
2.	Cozumel, Mexico	92
3.	Grand Cayman	87.5
4.	Little Cayman and Cayman Brac	83.4
5.	Bimini, Bahamas	82.8

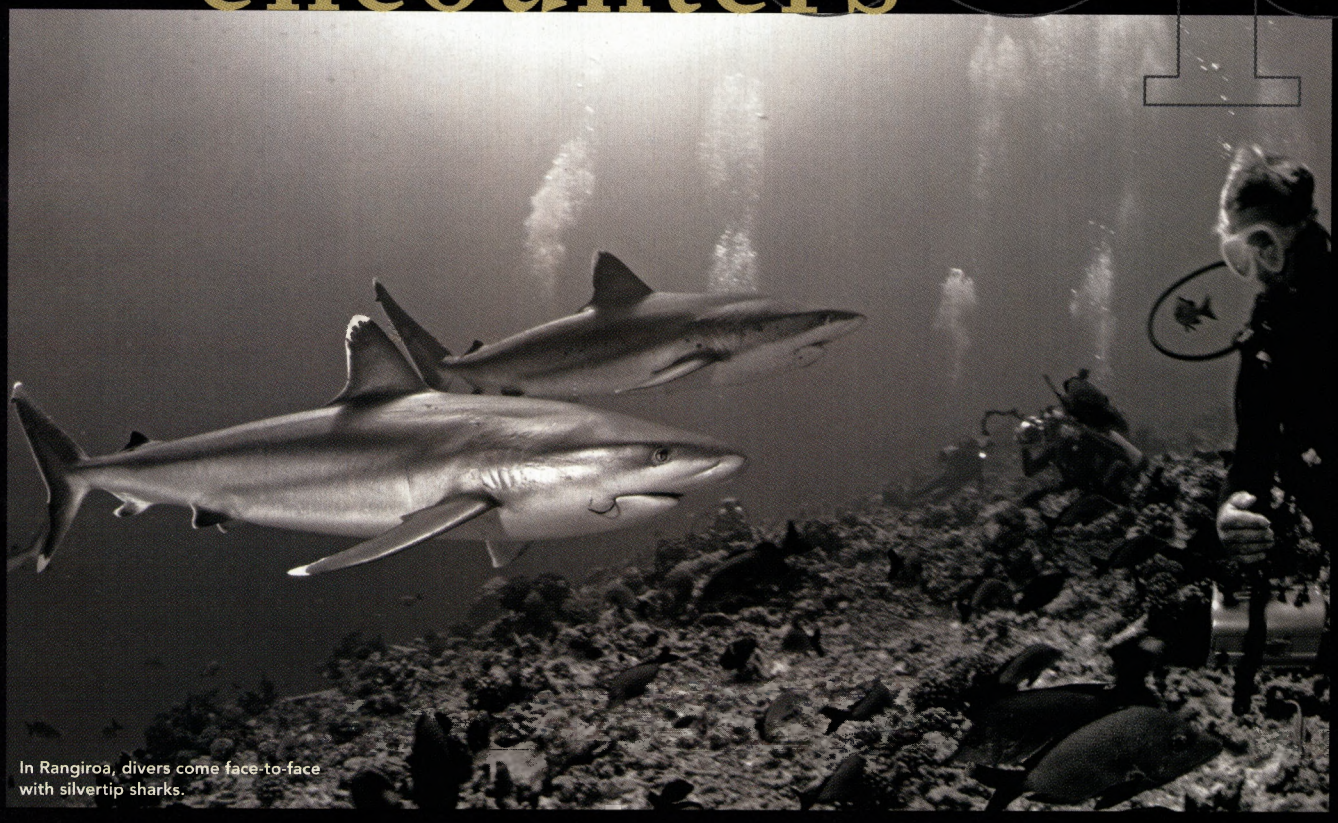
PACIFIC AND INDIAN OCEAN

1.	Papua New Guinea	95.5
2.	French Polynesia	92.3
3.	Big Island, Hawaii	91.5
4.	Palau, Micronesia	91.3
5.	Egyptian Red Sea	87.5

NORTH AMERICA

1.	Flower Garden Banks, Gulf of Mexico	72.6
2.	Southeast Florida	68.9
3.	Islamorada and Tavernier, Florida Keys	57.7
4.	North Carolina	55.7
5.	Key Largo, Florida Keys	51.9

top big animal encounters



In Rangiroa, divers come face-to-face with silvertip sharks.

STEPHEN FRINK

Top Big Animal Encounters

It doesn't matter how much you love the sea's little creatures, nothing can compare to sharing a stretch of ocean with an animal that outweighs you. Every year, divers spend thousands of dollars to get close to sharks, whales, dolphins and mantas, and every year, thousands of divers come home satisfied from destinations like the ones you see listed here. With regularly scheduled shark and dolphin dives as well as plenty of chance encounters, many islands in the Bahamas are favorite destinations of big-animal aficionados. In French Polynesia at atolls like Bora Bora and Rangiroa, gray sharks, silvertips and great hammerheads congregate in the tidal passes between lagoons and the open ocean. North Carolina is also known for sharks, in this case sand tigers, which circle the state's abundant wrecks. And, of course, no big-animal list would be complete without the mantas of Yap and the regular pelagic processions found at Palau and the Galapagos Islands.

CARIBBEAN/ATLANTIC

1.	Bimini, Bahamas	77.1
2.	Grand Bahama, Bahamas	74.6
3.	New Providence, Bahamas	71.4
4.	Cay Sal Bank, Bahamas	69.2
5.	Providenciales, Turks & Caicos	61.7

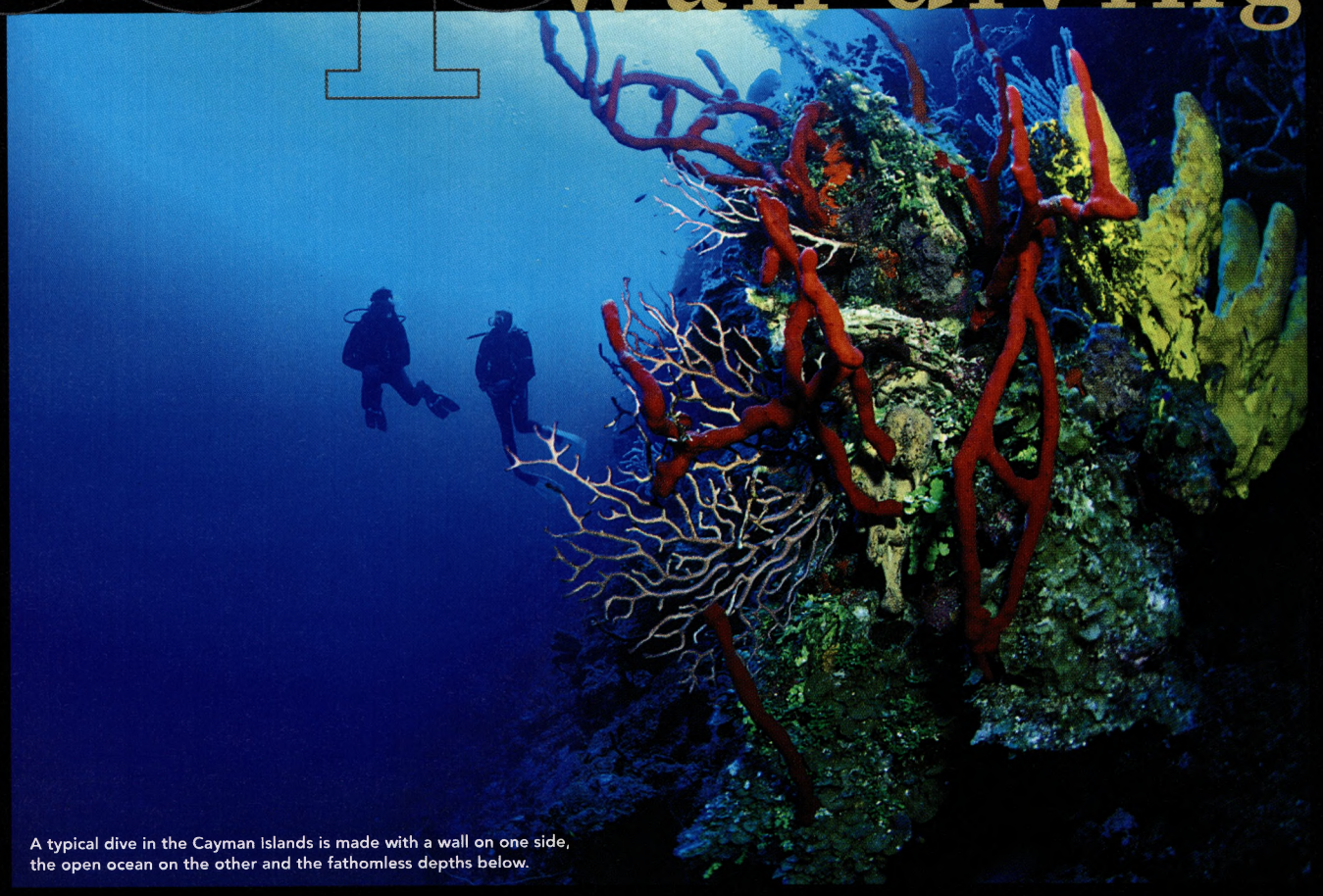
PACIFIC AND INDIAN OCEAN

1.	French Polynesia	100
2.	Yap, Micronesia	96.3
3.	Palau, Micronesia	96
4.	Galapagos Islands	92.1
5.	Cocos Island, Costa Rica	89.7

NORTH AMERICA

1.	North Carolina	69
2.	Flower Garden Banks, Gulf of Mexico	68.9
3.	Southeast Florida	64.7
4.	Channel Islands, Calif.	60
5.	British Columbia	52.4

top wall diving



A typical dive in the Cayman Islands is made with a wall on one side, the open ocean on the other and the fathomless depths below.

Top Wall Diving

Imagine yourself standing on the rim of the Grand Canyon, peering into its depths. Now imagine that those cliffs plunge to four times the depth of the Grand Canyon, are blanketed with a kaleidoscopic garden of living creatures, and that you can float down the cliff face at will, taking it all in. That's diving in the Cayman Islands, where the massive Cayman Trench drops from shallow reefs to abyssal depths right offshore the three islands that make up the wall diving capital of the world. The most fabled site in Pacific wall diving is the 600-foot drop at Palau's Ngemelis Wall, which is covered in soft corals and sea fans, and frequented by gray reef sharks and rays.

CARIBBEAN/ATLANTIC	
1. Little Cayman and Cayman Brac	94.9
2. Grand Cayman	94.4
3. Grand Turk and Salt Cay, Turks & Caicos	92
4. Cozumel, Mexico	88.4
5. U.S. Virgin Islands	85.5

PACIFIC AND INDIAN OCEAN	
1. Palau, Micronesia	96
2. Papua New Guinea	85.7
3. Egyptian Red Sea	81.8
4. Yap, Micronesia	81
5. Maui, Hawaii	77.7

NORTH AMERICA	
1. Washington State	94.4
2. British Columbia	91.3

STEPHEN FRINK

healthiest marine environment

CARIBBEAN/ATLANTIC

1.	Grand Turk and Salt Cay, Turks & Caicos	93.6
2.	Saba	93.3
3.	Bonaire	90.4
4.	Little Cayman and Cayman Brac	88.7
5.	Belize Atolls	88.2
	(tie) Cozumel, Mexico	88.2

PACIFIC AND INDIAN OCEAN

1.	Papua New Guinea	100
2.	Yap, Micronesia	96.3
3.	Palau, Micronesia	96.1
4.	Big Island, Hawaii	90.7
	(tie) Truk, Micronesia	90.7

NORTH AMERICA

1.	British Columbia	100
	(tie) Channel Islands, Calif.	100
3.	Flower Garden Banks, Gulf of Mexico	94.4
4.	Washington State	84.6
5.	Key West, Florida Keys	83.3

wreck diving

CARIBBEAN/ATLANTIC

1.	British Virgin Islands	97.1
2.	Bermuda	76.9
	(tie) Aruba	76.9
4.	New Providence, Bahamas	69.6
5.	U.S. Virgin Islands	67.7

PACIFIC AND INDIAN OCEAN

1.	Truk, Micronesia	98.1
2.	Egyptian Red Sea	92.9
3.	Oahu, Hawaii	75
4.	Australia (Great Barrier Reef and Coral Sea)	71.1
5.	Palau, Micronesia	63.5

NORTH AMERICA

1.	North Carolina	96.7
2.	British Columbia	89.5
3.	Islamorada and Tavernier, Florida Keys	77.4
4.	Key Largo, Florida Keys	77.2
5.	Southeast Florida	75.5

shore diving

CARIBBEAN/ATLANTIC

1.	Bonaire	98
2.	U.S. Virgin Islands	84.6
3.	Curaçao	78.6
4.	Grand Cayman	72
5.	Utila, Bay Islands, Honduras	66.7

PACIFIC AND INDIAN OCEAN

1.	Big Island, Hawaii	80.4
2.	Egyptian Red Sea	76.9
3.	Maui, Hawaii	76.5
4.	Kauai, Hawaii	60.6
5.	Oahu, Hawaii	60
	(tie) Truk, Micronesia	60

NORTH AMERICA

1.	British Columbia	81.8
2.	Washington State	80
3.	Channel Islands, Calif.	50
4.	Southeast Florida	37
5.	North Carolina	33.3

small animals

CARIBBEAN/ATLANTIC

1.	St. Vincent and the Grenadines	100
2.	Bonaire	90.5
3.	St. Lucia	82.1
4.	Little Cayman and Cayman Brac	81.5
5.	U.S. Virgin Islands	78

PACIFIC AND INDIAN OCEAN

1.	Papua New Guinea	100
2.	Egyptian Red Sea	91.7
3.	Thailand	88.9
4.	Palau, Micronesia	88
5.	Truk, Micronesia	87

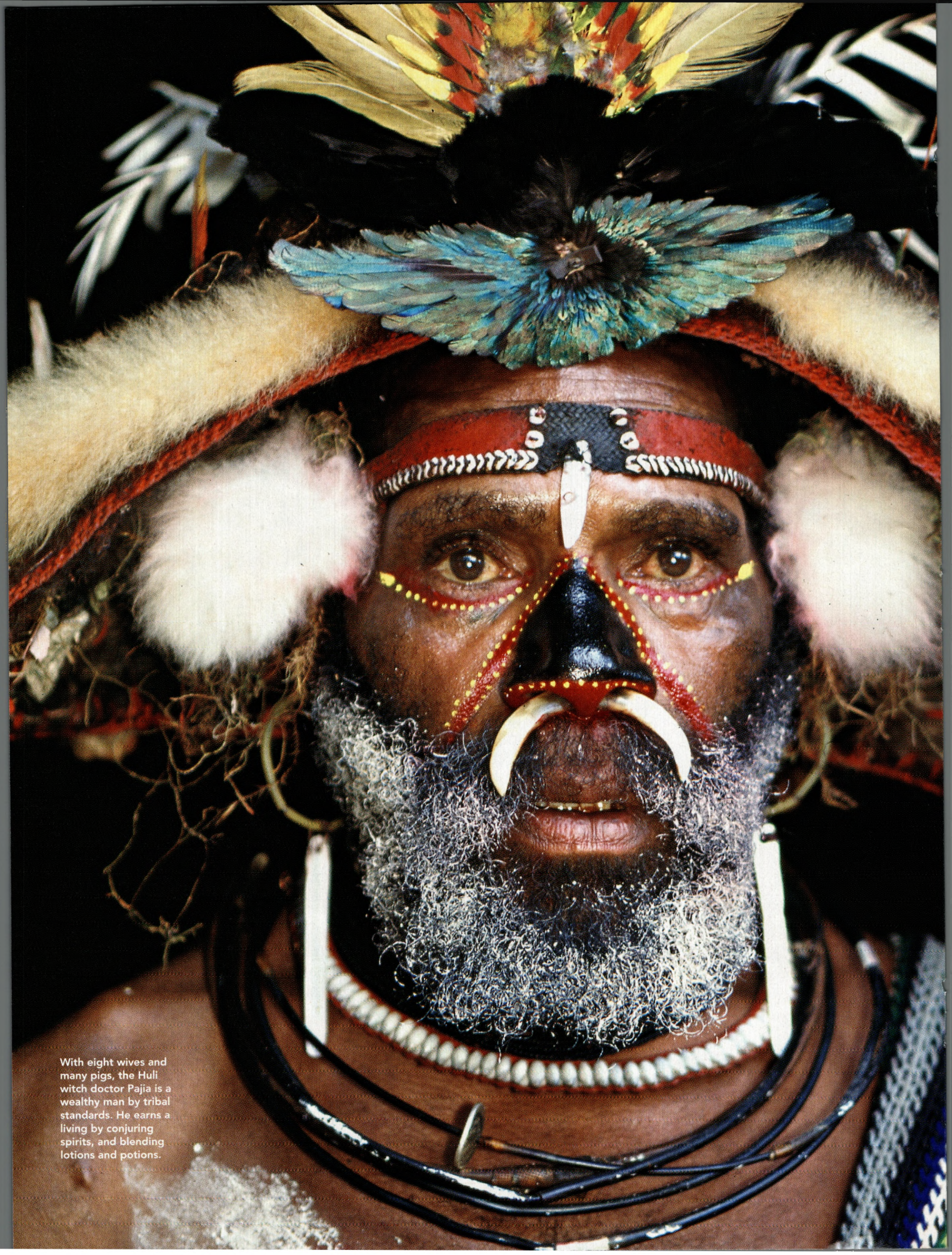
NORTH AMERICA

1.	British Columbia	96.3
2.	Washington State	95.8
3.	Flower Garden Banks, Gulf of Mexico	69.4
4.	Southeast Florida	68.5
5.	Channel Islands, Calif.	60
	(tie) Islamorada and Tavernier, Florida Keys	60

How We Got the Numbers

Thousands of *Scuba Diving* subscribers and web users rated their experiences at dive destinations in a variety of categories on a scale of one to five. Final scores represent the percentage of fours (very good) and fives (excellent) awarded. A minimum number of responses was required for a destination to be included in these ratings.

GET MORE > We couldn't fit it all in! To see more Readers' Choice Award categories, including top underwater photography, snorkeling, beginner and advanced diving, go to www.scubadiving.com/top100.



With eight wives and many pigs, the Huli witch doctor Pajia is a wealthy man by tribal standards. He earns a living by conjuring spirits, and blending lotions and potions.

DIVE Log

Papua New Guinea

(A VISUAL TOUR ABOVE AND BELOW)

BY STUART & MICHELE WESTMORLAND

THE PLANE BANKS OVER Papua New Guinea's mainland, and beneath you a fern-green jungle blankets the flanks of mountains that drop down to sugar-white sand and into the turquoise Pacific. But underneath the paradise-perfect scenery, Papua New Guinea is a land of immensities and complexities. It is a country of 600 islands spread out over hundreds of miles, with more than 700 languages, a troubled capital city and a ritualistic tribal culture.

This juxtaposition of the rare and wonderful plays out under water, too. Thousands of square miles of coral reef jammed with strange creatures. Water-darkening schools of fish. Dizzyingly deep walls. World War II wrecks. It would take more than a single magazine article to do it justice.

The sites highlighted here illustrate PNG's diversity. Loloata Island offers rare marine species. A trio of islands in the Bismarck Sea—New Britain, New Ireland and New Hanover—is the cruising ground of large pelagics. Finally, Tari Valley is the place to experience PNG's rich tribal culture.

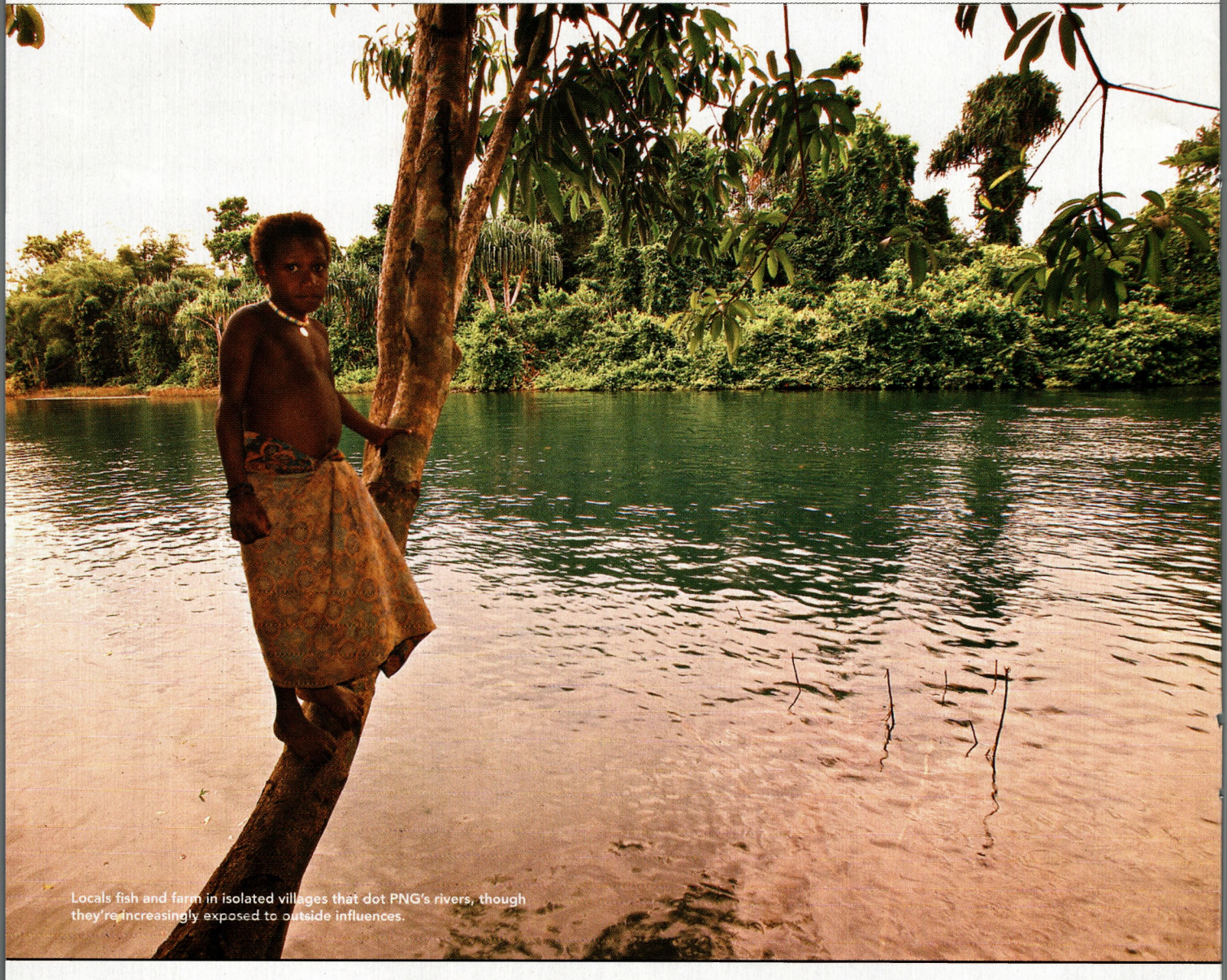
PHOTOGRAPHY BY **STUART & MICHELE WESTMORLAND**

LOLOATA MEANS "ONE HILL" in Motu, the language spoken locally. Visitors who arrive by boat are immediately greeted by the friendly crew and staff of Loloata Island Resort, which overlooks Bootless Bay. Only 20 minutes from Port Moresby, PNG's capital city, Loloata is a serene retreat where you can spend a day at the beach or enjoy world-class diving. The resort's comfortable dive boats whisk you to a myriad of sites. The pinnacle of Suzie's Bommie, adorned with red sea whips, pink sea fans, and huge barrel and elephant ear sponges, is alive with schools of batfish, sweetlips and other reef fish. Loloata also features a World War II aircraft wreck. The seagrass beds of uninhabited Lion Island shelter lots of small, weird creatures like white-faced morays, chocolate chip sea stars and harlequin pipefish, and is the destination of choice for muck divers.

In the Southern Highlands, Ambua Lodge's bungalows offer warmth in the cooler mountains. Above: Common lizardfish in PNG are bigger than their cousins in other oceans.

PNG's waters are thick with hundreds of species of schooling fish like these milkfish.

THE JUMPING-OFF POINT FOR DIVING IN THE BISMARCK SEA is Walindi Plantation, a still-operating oil-palm plantation on New Britain Island. Amazed by the biodiversity of Kimbe Bay, owner Max Benjamin built a dive resort and donated land for a nature center. The bay is home to hundreds of species of fish and coral, and the calm waters offer a respite to sperm whales, orcas and large schools of tuna. To reach the outer islands beyond Kimbe Bay in the Bismarck Sea, visitors can board one of three live-aboards that use Walindi as a base. *FeBrina*, *Star Dancer* and *Paradise Sport* can get to the Witus, where jacks and barracuda number in the thousands. It's an overnight crossing to the passes of New Ireland and New Hanover islands (the Kavieng area), where divers can drift-dive in a three-knot current alongside rays and sharks. On the eastern side of Kimbe Bay, the Fathers, named after New Britain's highest and still-active volcano, Mt. Ulauan, or Father, is just west of Lolobau Island. Even though it's in Kimbe Bay, this hook-shaped reef chain, packed with soft corals and gorgonians, is also accessible only by live-aboard. You may encounter a friendly pod of resident dolphins who often play in the boat's wake—and if you're lucky, with divers in the water.



Locals fish and farm in isolated villages that dot PNG's rivers, though they're increasingly exposed to outside influences.

Schools of chevron barracuda can be found throughout Papua New Guinea. Below: The rare *Rhinopias aphanes*, or weedy scorpionfish, mimics a crinoid as it lies in wait for prey.

THE VAST AND RUGGED HIGHLANDS of Papua New Guinea were the last of the country's territories to be explored by Europeans. Hike the lush, high-altitude rain forests of the Tari basin in the Southern Highlands, and you'll be treated to spectacular waterfalls and unusual fauna and flora like flamboyant birds of paradise, a cuddly member of the possum family called the cuscus and rare species of orchids. This is a primal landscape, and home to the tribe of wig-wearers known as the Huli. Fierce warriors, the Hulis are also excellent farmers and hunters. The gardens and domestic chores are tended to by the tribe's women, who often live separately from the men. In the Wig School, young Huli males make amazing, decorated wigs that are used in cultural heritage shows that are popular tourist attractions. The traditional song and dance called sing-sing is performed by brilliantly costumed locals on a regular basis. While the Hulis and other tribes living in the Highlands have been affected by the changes brought by outsiders, it is still possible for visitors to witness a way of life and culture found nowhere else in the world. SD

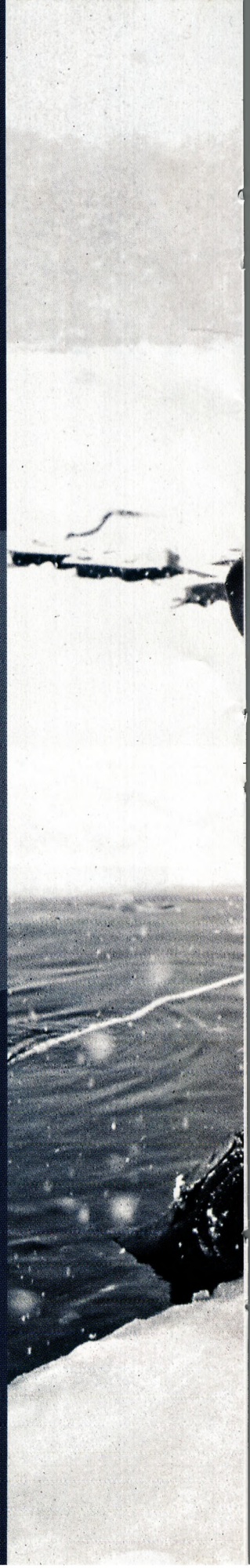
GET THERE > **For more information about Papua New Guinea, turn to In Depth, page 99, section 2.**

stay warm on any dive cold comfort

by john francis

MICHAEL LANG SAYS YOU CAN STAY WARM EVEN WHEN DIVING the coldest ocean on the planet. And he should know: As scientific diving officer for the Smithsonian Institution and the National Science Foundation, Lang supervises research diving under the Antarctic ice cap where the water temperature is actually below normal freezing (the salt keeps it from turning to ice down to 28.5 degrees). "Nowadays, there's no justification or argument for diving cold," he says. "You just have to match the equipment to the environment." If Lang can stay warm in those insane conditions using mostly ordinary equipment, the coldest lake, quarry or ocean you'll ever dive can feel like a bathtub.

photograph by chris jaffe



Even in the tropics, where water temperatures are a toasty 80 degrees or more, divers need to guard against thermal loss. That's because water is such a good conductor of heat, about 26 times more efficient than air at pulling heat out of your body. For example, 80-degree water chills a naked human as quickly as 42-degree air. That's why you need exposure protection, even in warmer climes, especially if you're making more than one or two dives a day.

If you're on a multiday trip and aren't careful to conserve your body heat, you may build up a caloric debt as the week goes on, which saps your desire to dive if nothing else. If you've ever felt compelled to swap your BC for a beach chair by the fourth day of your expensive dive vacation, something called "silent hypothermia" is probably the cause. You may not feel cold, but your body's furnace is running on empty.

More than comfort is at stake. There are dangers to diving cold too, dangers more immediate than the extreme case of clinical hypothermia, says Dr. Tom Neuman, a professor of surgery and medicine at the University of California, San Diego and director of the hyperbaric medicine center there. "What is a problem for a cold sport diver is that it makes him uncomfortable and he does dumb things," he says. "It's as if you were trying to do something complicated and serious, and someone had your fingers in a vise and was slowly tightening it."

Fatigue is the other result of cold that recreational divers are likely to encounter and probably the real reason for flopping into the beach chair instead of boarding the dive boat. Put simply, heat is energy, and energy dumped into the ocean is energy not available for diving.

stay warm

One of the easiest ways to dive warmer doesn't cost a dime: Be warm before you get in the water. It sounds obvious, yet many divers start their first dive more chilled than they realize, even in the tropics. Excited at leaving their snow blowers behind, they wear as little as possible—T-shirts and shorts, typically. Sometimes, that's not enough. Consider wearing long sleeves, at least in the evening.

Predive chilling becomes a serious problem on repetitive dives. It's not uncommon to lose more body heat during the surface interval than on the preceding dive, as anyone who has rushed back into the water to warm up knows. Wind-driven evaporation of water on the outside of your suit is a powerful cooling force, making it a pretty good swamp cooler. At the start of your surface interval, take off that wet exposure suit or towel it dry, and hide from the wind inside a parka or even a raincoat.

Another easy and inexpensive way to stay warmer while under water is to wear a hood. Exposure protection is like a corral in that no matter how high the fence is, it's useless if you leave the gate open. Likewise, no matter how much insulation you pile on, it's useless or nearly so if you leave large areas of your body exposed.

Your head, for example, accounts for about 10 percent of your body's total area, but it's responsible for 20 to 40 percent of your total heat loss. "There's a good reason for that," says Dr. Paul Webb, who conducted a decade-long investigation into heat loss for the U.S. Navy in the 1960s and wrote the chapter on "Cold Exposure" in the second edition of Bennett and Elliott's *Physiology and Medicine of Diving*.

Webb explains that in response to cold, near-surface blood vessels all over your body shut down so your warm blood is not cooled and your body heat is conserved. But "blood vessels of the head do not participate in that vasoconstriction. Scalp vessels don't shut down." So your heart keeps pumping your body heat to your unprotected scalp and out into the ocean at full speed. Then blood cooled by the ocean returns to your body core to suck up more heat. Your body's thermal horses are running through the open gate.

No one likes a hood, but there are ways to live with one. The first step, says Lang, is to "get the right size. If it's too tight, it will smash your jaw backwards and cause jaw fatigue." Some divers, like Dr. James Grier, a North Dakota State University professor who dives his state's frozen lakes and seems to enjoy it, likes a dry-suit hood even with a wetsuit because it has no yoke (the collar piece covering your shoulders) and allows easier head movement. Another option for less icy conditions is to enlarge the face opening with scissors so your jaw has more freedom. In the tropics, a neoprene "beanie" is the answer. With a strap under your chin, it fits like a bathing cap. Because it covers only your skull, which is rigid, you lose no mobility and will probably forget you're wearing it. It does most of the work of a full hood with a lot less aggravation.

wet or dry?

If you're staying warm between dives and protecting your head, you're doing the easy things. From this point on you have to focus on your exposure suit, and the first decision is choosing a wetsuit or a dry suit. Let's look at wetsuits first, because they have special problems dry suits avoid.

If any exposure suit is a thermal corral, many divers leave not only a gate open but a whole section of fence down. That's the result of wearing a shortie rather than a full-length suit. Your legs are as large a proportion of your total body mass as your torso, a bigger proportion of your skin surface, and "run hotter" when you're diving. That's because heat is created by muscle action, and it's your leg muscles that move when you dive. So you need to protect your legs at least as much as your torso.

There's another gate in a wetsuit's thermal corral that's inevitably open at least a crack: It almost always leaks. (If it doesn't leak at all, it's really a stripped-down dry suit.) If water enters your wetsuit, it will find an exit and will take your body heat with it. Even a small leak can cause a big flow because when you move your arms and legs, you expand and flatten the wrinkles and folds of your exposure suit, turning them into pumps. You don't feel water leaving because it's warm long before it gets to the exit, but it does, carrying your body heat with it.

A wetsuit zipper or a torn seam can be the source of a leak, but the biggest hole in your thermal defense is likely to be a wetsuit collar that doesn't make a good seal against your neck. Most of them, in fact, don't, and whenever you move forward, that collar scoops water into your suit. There's probably not a wetsuit diver alive who hasn't felt that icy river down his spine. Wetsuit collars are especially hard to seal because you move your head, neck and shoulders so often. Turning your head to left or right, for example, raises cords in your neck, which lift the seal and admit water. Bending your head forward to check your gauges opens the back of your collar. All that's another reason for wearing a hood, because its yoke will mate with the collar of the wetsuit and improve the seal. (When Grier uses a yokeless dry suit hood, he often wears a yoke cut from a conventional hood underneath; the two overlap but one can slide over the other, giving him some mobility.) Another solution is a hood attached to the body of your wetsuit that seals against your face well.

insulation

You've covered your head and stopped the leaks pretty well, but your wetsuit is still cold? You need more insulation. Many divers mistakenly believe that the layer of warm water trapped next to their skin by their wetsuit helps keeps them warm, but this is not the case. In fact, water conducts heat fairly well, better than rubber for example, and you'd be warmer without it. The most you can say for that water layer is that once you've warmed it up it's not doing as much harm as when it was cold. The only insulation worth considering is air or some other gas like nitrogen, and all the insulation in neoprene is in the tiny bubbles scattered through it. The neoprene itself is only the matrix that supports the bubbles.

But before you start adding more layers of neoprene, ask yourself whether the neoprene you're already wearing is still doing its job—that is, still has all its bubbles intact. Even if you never use your wetsuit, its bubbles collapse with time, and the pressure of deep diving or of dumping your scuba weights on top of it collapses them faster. The life span of a wetsuit is probably one to five years, depending on how good it was to begin with and how hard it has been used. At the end of that time it may still look fine—there's no real way to tell by looking at it—but it won't keep you as warm.

diving dry

If you're wearing a new wetsuit, it's as thick as you can stand, it doesn't leak, yet you still feel cold, it's time to consider a dry suit. There's only so much neoprene can do. As founder of DUI, one of the leading makers of dry suits, Dick Long can't be expected to be impartial. But he gives wetsuits their due. "Never go to a higher technology than you have to, and there are times when a wetsuit is fine technology," he says. "It simply is technology that has its limitations."

Its biggest limitation? It compresses, and its insulating bubbles flatten, when you dive deep. And not so deep. Most wetsuits will lose nearly half their thickness in the first 35 feet. By 90 feet, a 7mm wetsuit will be less than 2mm thick, and most of that 2mm is rubber, not insulating gas. Wetsuits are most effective in shallow water.

A dry suit, by contrast, loses no insulation no matter how deep you dive because you inject air into it to counteract the flattening effect of pressure. It's as if you could reinflate each of the tiny bubbles in your wetsuit as you descend, but in the case of a dry suit you're actually inflating the clothing you wear inside the suit. Clothing keeps you warm only because it traps air among its fibers.

Another advantage of a dry suit, Long says, is that by layering undergarments, you can easily vary the amount of insulation you wear to match the conditions. With different undergarments, a single dry suit can match or exceed a closetful of neoprene, from a thin tropical skin to a polar wetsuit. Many dry suit divers use a thick layer and/or a thin layer for three thickness possibilities. For example, he might use a thin fleece jumpsuit for water in the high 60s, a thick fleece suit for the low 60s, and both together for water in the 50s. Shirts, pants and vests give other layering options. Almost any combination of clothing, from T-shirts to snowsuits, can be used with a dry suit.

Dry suits are more expensive to buy than wetsuits, though they last much longer. Long insists the per-dive cost is actually less. Dry suits do require some maintenance, to their seals, valves and zipper. If they don't get it, they can leak, and if the leak is big, you'll get cold fast.

Buoyancy control is a little different, and proper weighting is more important with a dry suit than with a wetsuit. But the difficulties are trivial compared to, say, calculating no-decompression time for a repetitive dive. The payoff is that you can be really, actually, no-kidding warm after three or four dives and ready for more. Even in Antarctica. Where, Michael Lang says, "wetsuit divers on a research cruise will do a face plant into their dinner plate they're so exhausted, and the dry suit divers will stay through dinner and work another four hours in the lab with their specimens."

And you can be just as warm in a wetsuit if the water's not too cold or deep. Lang says flatly, "There's no reason people have to dive cold these days." SD

WHAT IS HYPOTHERMIA?

"Put simply, hypothermia is the lowering of the temperature of your body core," says Dr. Tom Neuman, a professor of medicine at the University of California, San Diego. As it cools from 98.6 to 95 degrees, your body enters mild hypothermia. You feel cold, you shiver and you lose some hand coordination. Your body restricts circulation to your extremities to concentrate warm blood in the core. When you start shivering, return to the surface where you can get warm.

Below a core temperature of 95 degrees, you're in moderate and then severe hypothermia. You will stop shivering and may even feel warm, but major organs are now in severe distress. You will be confused, apathetic, drowsy and uncoordinated. Your heart rate will slow and become erratic. Eventually, coma and death will follow. This is very unlikely for divers, however, because once you start shivering you will almost always leave the water.

LESSONS FOR Life

DIVE ACCIDENTS, CLOSE CALLS & HOW YOU CAN AVOID THEM

By Michael Ange

FILE:

#69

(THIS IS A TRUE STORY, BUT THE NAMES HAVE BEEN CHANGED.)

A FATAL MISCALCULATION

Bill's gas consumption numbers didn't lie, but they didn't account for emergencies, either. Now his wife has to live with the consequences of his bad decision.

ALONE INSIDE THE CAVE, Bill finally located the guideline and his breathing relaxed to an almost normal pattern. He might make it out after all. Just a few yards farther along, he found the line arrows pointing toward the exit—1,400 feet to go. The tension eased from his body as he swam deliberately toward the exit. Then his regulator began to breathe hard. The equipment must be malfunctioning, he thought. What else could go wrong? Switching to his alternate, he found even more resistance. Terror struck when he saw his pressure gauge needle pegged at zero.

PHOTOGRAPH BY **WES SKILES**

Meanwhile, on the surface, Jan put aside her book and anxiously searched the still surface of the spring for bubbles. Her husband Bill was nearly an hour overdue. She approached a nearby cave instructor to report her husband missing. The concern in the instructor's face as she spoke drove her to near panic and she became inconsolable as he used his cell phone to call for a recovery team.

THE DIVER

Bill was a healthy, experienced cave diver in his mid-40s with a background in engineering and mathematics. After completing dozens of cave dives, he decided to try a new challenge by going it alone. After several solo cave dives, Bill began to tinker with the rules used in cave training.

In discussions with cave instructors, Bill argued that the gas management protocol known as the rule of thirds was inefficient for an experienced solo cave diver like himself. The one-third reserve he'd been trained to keep was just wasted gas since there was no other diver who might need it. Based on his calculations, Bill decided to discard the tried-and-proven rule of thirds.

After a few uneventful dives using a rule of halves plus a 500-psi reserve, Bill was convinced that his technique was appropriate, even though several noted cave divers and instructors warned him against the practice.

THE DIVE

It was a brisk fall morning when Bill began his dive in a remote North Florida spring. After a final check of his equipment, he glanced back at his wife, leaving her contentedly reading a book. The water was clear and the current moderate when Bill secured his line to the rock outside the cave and began his initial penetration to the permanent line anchored 100 feet inside. Along the way, he switched from regulator to regulator to ensure proper function and checked all other equipment, satisfying himself that all was well with his gear.

He secured his reel to the cave's permanent guideline, marked the line with his identifying marker and continued his dive. When he reached his turn pressure of 500 psi over one-half of his tank, Bill noted with pride that he had penetrated farther into the system than on any previous dive. He took a few moments to revel in the beauty of the cave structure before turning for the exit. He swam several feet back down the passageway before he realized that the guideline was no longer in sight.

THE ACCIDENT

Bill's training kicked in. He tied the line of his safety reel to the wall of the cave and began a systematic search for the guideline. Although he did eventually locate the line, the slow, deliberate search and the anxiety of losing the line probably accelerated his breathing, and he lacked sufficient air to complete the exit.

ANALYSIS

The recovery team found Bill's body adjacent to the permanent line just a few hundred feet from the cave's exit. A forensic check of his equipment showed everything to be functioning properly, but his tanks were completely empty. Bill was found with some of his equipment removed, apparently discarded in the throes of panic as he realized that he would not survive the dive.

The rule of thirds is cave diving's tried-and-true method of gas management. It calls for divers to use one-third of their gas supply for entering and leaving a site, one-third for exploring and to keep one-third in reserve for emergencies. Like many divers, Bill falsely assumed that the one-third reserve is for sharing with a distressed buddy. In reality, its purpose is to allow time to deal with any emergency. Bill's primary mistake was failing to separate the certainties of mathematics from the harsh uncertainties of the real world.

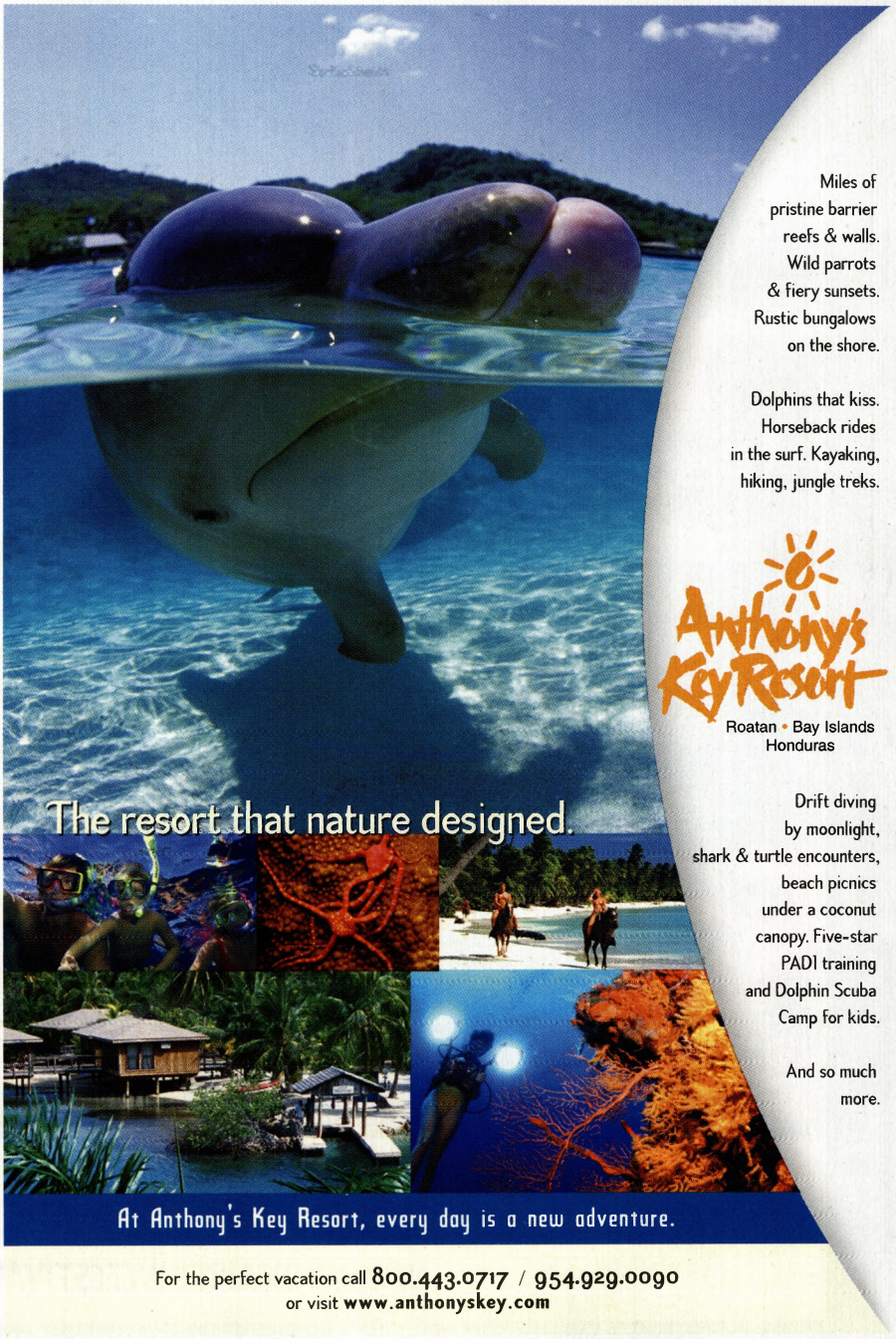
Bill wasn't the only victim of his miscalculation, a thought that no doubt occurred to him in his final moments as he thought of his wife of 20 years waiting for him at the surface. Technical divers may be willing to assume great risk to push the bounds of underwater exploration, but their family members may not be so willing. Sobbing with grief as recovery divers removed Bill's body from the spring, Bill's wife was proof that he had miscalculated more than just his gas supply. SD

LESSONS FOR LIFE

1 **FOLLOW THE RULES.** The rules of diving are well-founded, validated and verified with tragic statistics. Don't become one.

2 **BEWARE OF MURPHY'S LAW.** Dive plans frequently go awry; therefore, every plan should include contingencies for foreseeable, but unexpected, challenges.

3 **CONSIDER NONDIVERS.** Perhaps an added step in dive planning would increase the safety of our sport among advanced divers: Consider all possible outcomes of your actions, including the consequences that may befall your loved ones in a worst-case scenario.



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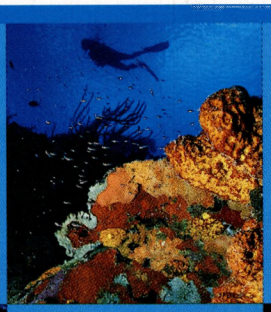
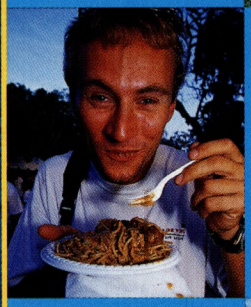


Demos

June 5-19, 2004

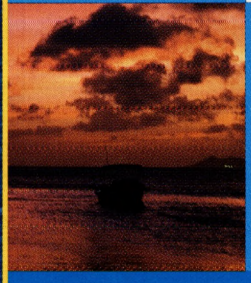


Parties

The Bonaire Dive Festival, scuba diving's premier event, will offer more fun and more diving in 2004. Come anytime during the two weeks to experience the world's easiest diving and join in exciting island-wide events, including diving, contests, demos... you can even observe Wyland as he paints a giant mural at the airport! No matter whether you're a beginner diver or advanced, coming by yourself or with your family, the Bonaire Dive Festival is an adventure-packed vacation of a lifetime. Contact your dive travel provider for specially-priced packages.

Contests
& Prizes

Join Wyland
in painting
the airport



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Gear

Alternate inflation regs eliminate the traditional octopus hose and put your backup within easy reach.

SCUBALAB

Better Alternatives

Our test shows alternate inflation regulators can deliver big air when the pressure is on. **BY JOHN BRUMM**

WHEN IT COMES to alternate air sources, it's hard to beat the streamlined functionality of an alternate inflation regulator. These fully functional regulators connect to, or are integrated into, your BC's power inflator, eliminating the traditional octopus hose and putting your backup reg close to your mouth and within easy reach.

It's not easy to build an inflator/reg because you have to cram a lot into a small housing—an ergonomically correct mechanism for inflating and deflating the BC, coupled with a reliable regulator that delivers a low work of breathing. But today's inflator/regs are relatively inexpensive, easy to install (although most manufacturers recommend your dive store do the installing), and most provide surprisingly easy breathing, as good as or even better than traditional octopus regs. They are designed to be connected to any first stage as long as the first stage's intermediate pressure falls within the inflator/reg's operational parameters (more on that later), which virtually all first stages do.

Bottom line: Inflator/regs are proven technology. Most models on the market perform well, but as we discovered in our test of eight of recreational diving's most pop-

PHOTOGRAPHY BY **MITCH MANDEL**

ular inflator/regs, the newest designs have raised the bar in breathing performance and ergonomic design.

PUTTING THEM THROUGH THEIR PACES

OUR FIRST STOP was the Dive Lab, an independent test facility in Panama City Beach, Fla., where we do all of our breathing machine testing. Here the units were hooked up to an ANSTI breathing simulator and tested at two depths: 132 feet salt water (fsw), recognized as the maximum recommended depth limit for recreational scuba diving, and 165 fsw, the test depth used in the European testing standard EN-250. At those two depths, the inflator/regs were subjected to two breathing rates or respiratory minute volumes (RMVs): 37.5 RMV, considered a moderately aggressive breathing rate, and 62.5 RMV, a heavy-work breathing rate, both of which can be used to simulate a nervous, stressed or panicked diver.

To make sure we were focusing on the performance of the inflator/regs rather than on another component in the system, we used the same regulator first stage for all tests. Its intermediate pressure was set at 136 psi, which not only falls right in the middle of most manufacturers' recommendations, but also represents the mid-range pressure setting of most first stage regulators. The supply pressure to the first stage was maintained at 725 to 765 psi, which is the standard pressure range used for European testing and past ScubaLab tests.

The breathing machine measures work of breathing, or how much effort a diver has to put into inhaling and exhaling, expressed in joules per liter (j/l). The lower the number, the easier the breathing. European standards set the maximum breathing effort at 3 j/l, which is also what we use in our tests. We started each inflator/reg at the surface breathing at 62.5 RMV, then slowly took it to 132 feet. If the unit could handle that depth within the 3 j/l standard, we took it down to 165 feet. If the regulator couldn't make it to 132 feet, the maximum depth achieved was recorded and the cycle was completed at the lower breathing rate of 37.5 RMV (see chart, pg. 101).

When a regulator exceeds 3 j/l, it "fails" our test for the given RMV/depth. That doesn't mean that it stops working, just that the effort it required exceeds what has become acceptable for modern recreational gear.

Once the simulator tests were done, our test divers took them on repeated ocean dives. Each unit was scored on four crucial ergonomic points: ease of breathing in various positions, whether it breathed wet or dry, how easy it was to purge the inflator/reg, and how easy the controls—inflator button, deflator button and regulator purge—were to find and use, both when using the unit as a BC inflator, and when using it as a regulator.

ATOMIC AQUATICS
SS1

THE OVERALL RESULTS

When all test scores were tallied, we found:

> At 132 feet, most of the inflator/regs we tested deliver **good** to **excellent** (see: "Defining Our Terms," pg. 78) breathing performance, with at least some degree of reserve capacity. In an emergency situation within recreational dive depths, these models will provide a smooth, steady flow of air relatively effortlessly.

> The two newest models tested deliver breathing performance so smooth and with so much reserve capacity that even at the heavy-work RMV at 165 feet, they have performance to spare.

> Only one model's performance fell noticeably short of the others.

> In the ergonomic tests, divers found that all the units listed here were easy to access and use. All breathed dry, and our testers' scores for user controls ranged from **good** to **excellent**.

THE TESTERS' CHOICES

Atomic Aquatics SS1 This new inflator/reg offers performance to spare in a user-friendly package. The SS1 breathes better than many primary-use regulators and generated the best overall simulator performance among the integrated inflator/regs (only the Gemini, which does not incorporate an inflator into its design, could beat it), then hit the water and earned the highest ergonomic scores of all the units we tested.

A low profile enables the SS1 to lie relatively flat against the BC. Large, contoured inflate/deflate buttons are positioned on the top of the housing and, according to our test divers, they're comfortable and easy to operate with one hand, even when the SS1 is in your mouth. An efficient purge is located on the end of the unit.

A unique feature of the SS1 is a threaded coupling that enables you to unscrew the inflator/reg from the end of the corrugated hose so you can transport and store it along with your primary regulator and gauges, or easily switch it between your tropical BC and your temperate-water BC. The SS1 also includes a set of adapters and hardware to fit virtually any BC's corrugated hose and remote dump valve assembly. This unit is available in stainless-steel and all-titanium versions. The titanium version is lighter and provides added corrosion resistance.

Genesis Gemini GS 070 Genesis's new Gemini is essentially an octopus regulator built into an inflator hose that works with your BC's existing power inflator. Simply substitute your BC's low-pressure supply hose with the Gemini's hose and attach the quick-connect fitting to the power inflator. That's all there is to it.

On the simulator, the Gemini delivered the lowest work of breathing—in all RMV/depth categories—of all the units in this test. In fact, it breathes better than many primary regs. In the water, test divers report it's a dry, smooth breather.

There's a sensitivity lever on the side of the housing, similar to a dive/pre-dive switch so you can de-tune it to prevent free-flows. The Gemini can be used with virtually any power inflator and at $130 it's also a Best Buy.

THE VERY GOOD PERFORMERS

WHILE THE NEWEST inflator/regs took Testers' Choice honors, five earlier models currently on the market remain top performers. Within recreational diving depths (and even to 165 feet), they all deliver **excellent** breathing scores at a moderate breathing rate. While none of these models was able to attain the extreme RMV/depth performance level—a test designed to highlight reserve capacity—they provide solid performance at recreational depths, and have a track record for reliability. Test divers rated their in-water performance as **very good** in virtually all ergonomic categories.

OCEANIC
Air XS 2

Oceanic Air XS 2 With **excellent** scores for moderate breathing loads at 132 and 165 feet, and **very good** breathing machine performance

GENESIS
Gemini GS 070

AERIS
Air Link

TUSA
Duo-Air

ZEAGLE
Octo+MKII

AQUA LUNG
Air Source II

under heavy breathing loads at 132 feet, the Air XS 2 leads this pack of earlier models when it comes to breathing performance.

Our test divers found it to be a smooth, dry breather in all positions, and liked the compact, low profile. They gave it **very good** scores across the board in all ergonomic testing categories, except for the position of the inflate and deflate buttons, where it earned a **good** rating. Our divers found the position of the buttons makes one-handed operation a bit awkward.

The Air XS 2 can be attached to most existing BC corrugated hoses or can be purchased as a complete unit.

Aeris Air Link In both form and function, the Aeris Air Link is a twin to Oceanic's Air XS 2 (the Air XS 2 has a slightly longer corrugated hose) and offers virtually identical breathing machine performance—**excellent** scores for moderate breathing loads at 132 and 165 feet, and **very good** under heavy breathing loads at 132 feet.

Test divers say the Air Link breathes dry with minimal effort and offers an effective purge button. The purge sits on top of the inflator/reg housing between the inflate and deflate buttons. This produces a more low-profile housing, but makes it a bit awkward to use one-handed. At a suggested retail price of $159.95, it's a Best Buy.

Tusa Duo-Air Delivering **excellent** performance on the simulator and **very good** performance in the water, the Duo-Air is as easy to use as it is to breathe from. Tusa puts the Duo-Air's control buttons on top of the housing like the Atomic SS1, although they are smaller and not as conveniently shaped. But the positioning is good, allowing for easy one-handed buoyancy control whether you've got the Duo-Air hanging from your shoulder or clenched between your teeth. The purge is located on the end of the housing and incorporates a small button that can be awkward to depress when wearing gloves.

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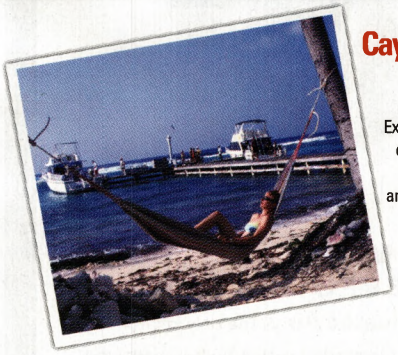

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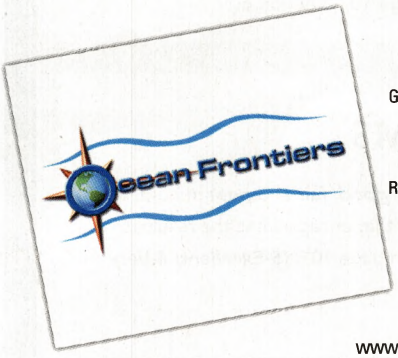

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Zeagle Octo+MKII With simulator and ocean performance nearly identical to the Duo-Air, Zeagle's Octo+ is a smooth, dry-breathing alternate inflation reg. What is different between the two inflator/regs is button placement; the Octo+ has its inflation and deflation controls on the underside of the housing. At first this positioning seems awkward; however, once you get used to it, it's actually quite efficient. The buttons are close together so, with a little practice, you can operate both buttons with just your thumb while gripping the inflator. An efficient purge sits out at the end of the housing.

Aqua Lung Air Source II This second-generation inflator/reg is designed with the deflator button on top and the inflator button underneath. This button placement makes it easy to regulate buoyancy one-handed with the Air Source II hanging from your shoulder; however, when it's in your mouth it is not quite as convenient. A powerful regulator purge is located on the end of the housing.

The Air Source II delivered **excellent** simulator performance at both test depths using the moderately aggressive breathing test rate, but couldn't quite reach 132 feet at the heavy-work RMV. It was, however, able to reach 109 feet before exceeding test parameters.

In the water, test divers found it to be a very smooth breather and dry in all positions. It's available as just an inflator/reg or as a complete unit with a dump valve and corrugated hose.

AQUATEC
Air 3

LIMITED PERFORMANCE

Aquatec Air 3 The only inflator/reg on the market with a built-in horn, the Air 3 will produce about 120 decibels of teeth-chattering noise above water, and a duck-like honk below. However, the breathing characteristics of the Air 3 are nothing to brag about. On the simulator it wasn't able to reach any of the RMV/depth test levels. It exceeded our test parameters at 109 feet at the moderately aggressive breathing rate. Consequently, we don't recommend the Air 3 for diving deeper than 100 feet.

In the water, test divers (who didn't know the results of the breathing machine tests) said the Air 3 breathed noticeably harder—even at shallow depths—than all the other units, but gave it a **fair** rating for ease of breathing on dives to about 65 feet. They also reported that it breathes dry and the buttons were easy to use. SD

GET MORE > For more information and charts on the alternate air sources tested, turn to In Depth, page 101, section 6.

DEFINING OUR TERMS

When you see the words ***excellent***, ***very good***, ***good***, ***fair*** and ***poor*** in bold, they represent a numeric score on a five-point scale that encapsulates the results of our tests. For additional detail, see the chart on page 101. (***5-Excellent; 4-Very Good; 3-Good; 2-Fair; 1-Poor***)

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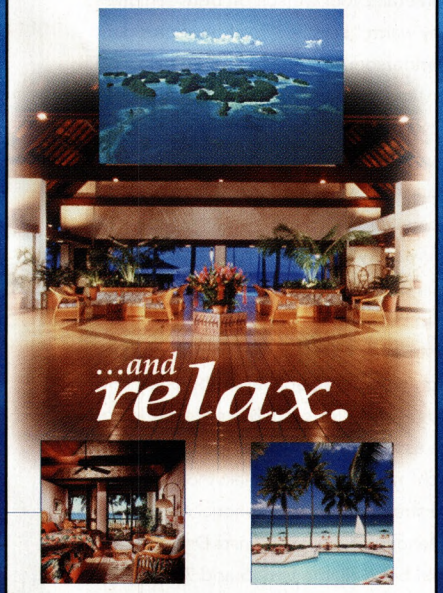
Welcome to Palau



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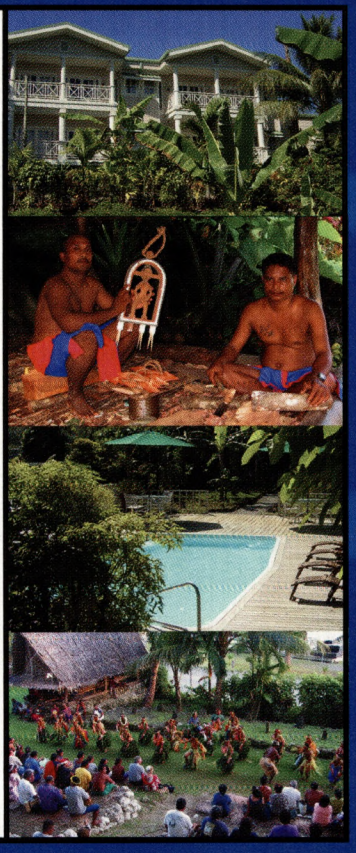

Cool New Gear

A drier wetsuit, fins with kick and four bright lights.

HENDERSON AQUATICS "Insta Dry" Wetsuits Something's missing here: the layer of nylon cloth that's usually bonded to the outside (and sometimes the inside) of a wetsuit. What's wrong with cloth? It absorbs and traps water, which, when it evaporates in the wind during your surface interval, chills you like a swamp cooler. It's not uncommon to lose more body heat during the surface interval than during the dive.

Smooth surfaces, by contrast, shed water quickly and can be toweled dry. Little or no evaporative cooling should mean a warmer second dive. "You needn't take your wetsuit off between dives to stay warm," says Joe Polak, vice president of Henderson Aquatics, and if you do "it'll be dry and warm, not cold and clammy, when you put it back on."

Another plus: Traveling divers will be able to pack a dry wetsuit only minutes after their last dive.

"Insta Dry" neoprene is actually a trilaminate. For strength, a layer of nylon is sandwiched between two layers of neoprene in a patent-pending technique. The outer surface is slightly textured so weight belts and BC straps won't slip off. The material is not quite as stretchy as the company's "Hyperstretch" neoprene, says Polak, though it's still more stretchy than conventional neoprene.

Henderson Aquatics "Insta Dry" wetsuits should be available in 3, 5 and 7mm thicknesses by April. **(Henderson Aquatics, www.hendersonusa.com)**

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TILOS Mach II Turbo Fin We first got a look at this unique fin last year when it was hot off the injection molds. We weren't able to include it in our 2003 fin review because at the time of the tests the designer was embroiled in patent disputes. The lawyers have finally left the building, and the Mach II Turbo is now available with some slight modifications to the original design. The fin still has its unique blade design incorporating a horizontal split, which creates sort of a "flapper" effect. But this new version seems slightly stiffer, its thick side rails are contoured and, most noticeable, the fin now has variable-thrust "Power Tabs" that enable you to adjust (one time only) the flexibility of the flapper portion of the blade by removing up to three tabs. It's an interesting-looking fin, and we look forward to taking the Mach II Turbo through its paces in our next big fin shootout. Available in XS-L. $193.88. **(Tilos, www.tilos.com)**

UNDERWATER KINETICS Fathom 4 Pak This dive light pack offers a torch to meet any underwater need. Largest of the group is the Sunlight C8 pistol grip, a medium-beam powerhouse with a dual-bulb system that lets you switch to the backup bulb under water. Then there's the Sunlight SL4 pocket light with a concentrated beam and powerful hot spot, the narrow-beam Mini Q40 with good peripheral illumination, and finally, the red-glow Dive Beacon for hanging on your tank during a night dive or for aiding in night vision on a darkened boat deck. All lights are molded in new high-visibility fluorescent yellow. $118. **(Underwater Kinetics, www.uwkinetics.com)** SD

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Night Moves

If you only shoot the reef when the sun's out, you're missing half the fun. **TEXT AND PHOTOGRAPHY BY STEPHEN FRINK**

AS ANY EXPERIENCED NIGHT DIVER KNOWS, the coral reef undergoes a dramatic change when the sun goes down. Creatures that are hidden during the day come out in droves. Tiny invertebrates and crustaceans you'd never see during the light of day roam the reef at night, while

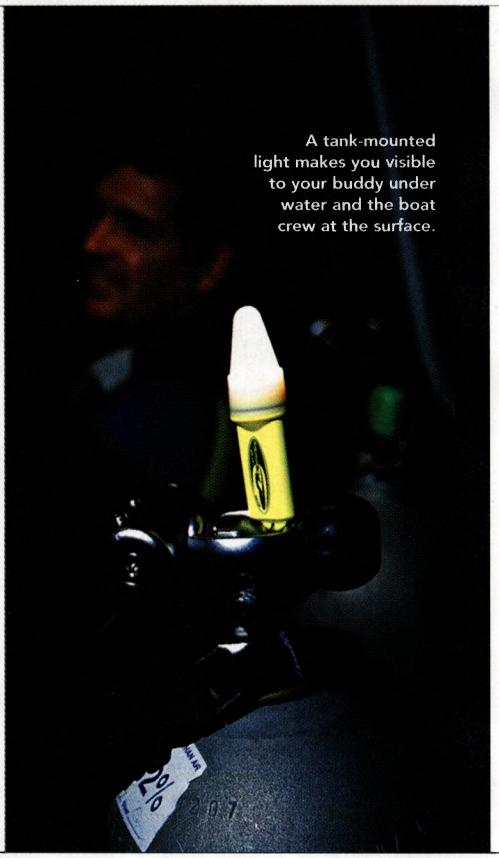
other creatures that are elusive during the day are somnambulant at night. Their rest time can be your photographic bonanza. Having trouble capturing a butterflyfish within your wire-framed close-up kit during the day? It's a slam-dunk at night. Tired of parrotfish bolting when you get within four feet of them during the day? Catch them tucked into their mucous cocoon at night.

You won't shoot big schools of fish—the grunts and snappers will be somewhere else for the evening—but you'll find turtles sleeping under ledges and lobsters and crabs tucked into hidey-holes across the reef. Abstract compositions of creatures like brittle stars and extreme close-ups of fish eyes can all be part of the evening's image capture. Even the backgrounds are different at night, when coral heads are fuzzy with polyps extended for feeding and the open water is black instead of blue.

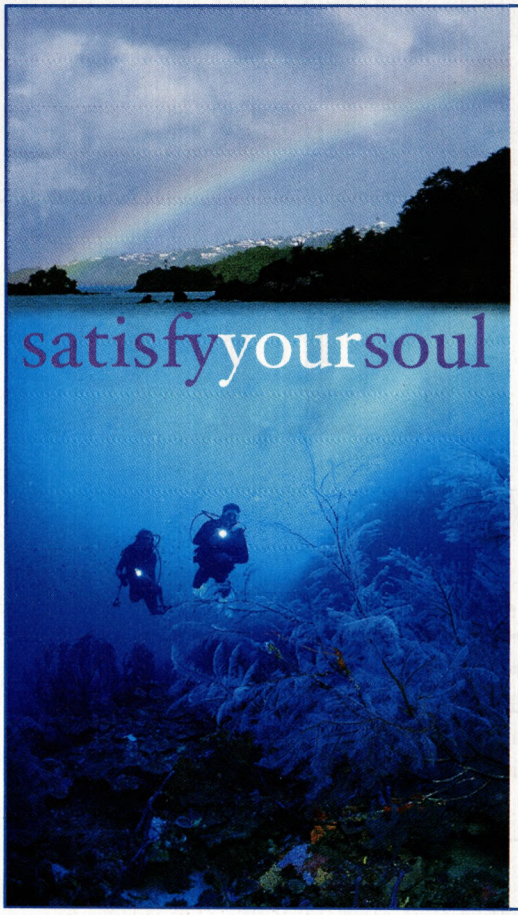
THE GEAR

NO MATTER WHAT camera system you use, you'll need some form of underwater light. And, since your hands will likely be full of camera gear, fumbling around with a normal handheld dive light is a sloppy solution. Lights mounted to your mask might work well when using a Nikonos or other point-and-shoot system, but won't do you much good when you press your eye to the viewfinder of an SLR. Typically, you'll need some way for your camera system to illuminate the subject while your eye is trained to a viewfinder. There are three options for hands-free torch operation at night:

> **Built-in model lights:** Certain strobes,



A tank-mounted light makes you visible to your buddy under water and the boat crew at the surface.



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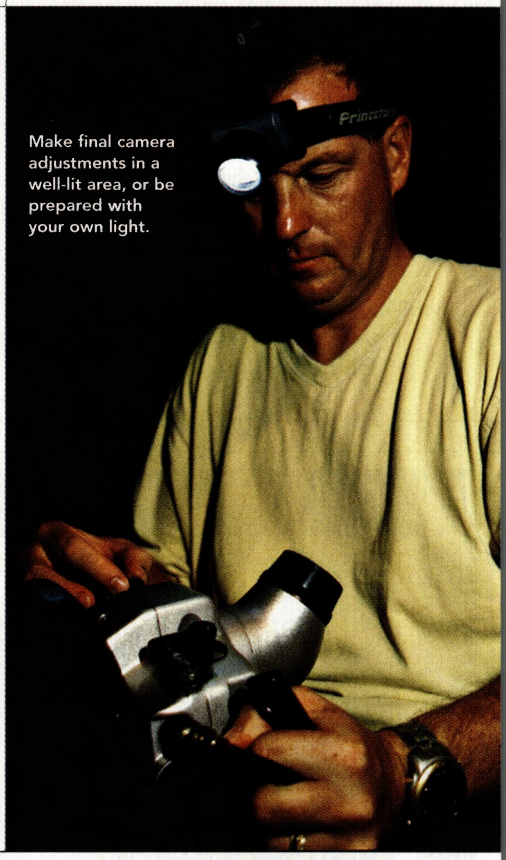
like the Ikelite 200/DS125 and Inon Z-220, have very powerful built-in modeling lights that provide sufficient illumination for night diving. Because the quartz bulbs are either within or adjacent to the strobe reflector, so long as the strobe is aimed at the subject (as it should be), you'll have plenty of light for composition and focus. The Inon actually takes it a step further by providing both a normal model light and a red laser spotting beam. As some creatures of the night are scared away by the bright light and heat from a quartz or halogen bulb, the laser provides a stealthy way to approach them. An integrated model light on a strobe can also serve as a focus-assist light when working under ledges or in low ambient light during the day. Note that not all model lights are equal in terms of adequacy as a stand-alone dive light. The now-discontinued Nikonos SB102 had what was called a "model light," but was actually a tiny, dull tungsten beam that did little except reduce battery life.

> **Strobe-mounted accessory lights:** In a pinch, you can always duct-tape or rubber-band a small dive light to the strobe head, but there will be parallax. The strobe head will not be lighting exactly the same area illuminated by the dive light. At four feet away that might not matter, but at the close-focus distances possible at night, it can mean that the strobe won't light the subject as you intend. Some shooters prefer to slip a small wedge under the back end of the light to make the beams more coincident at normal shooting distances. In fact, some manufacturers of strobe holsters intentionally angle the light downward. But still, this is at times an awkward compromise.



Make final camera adjustments in a well-lit area, or be prepared with your own light.

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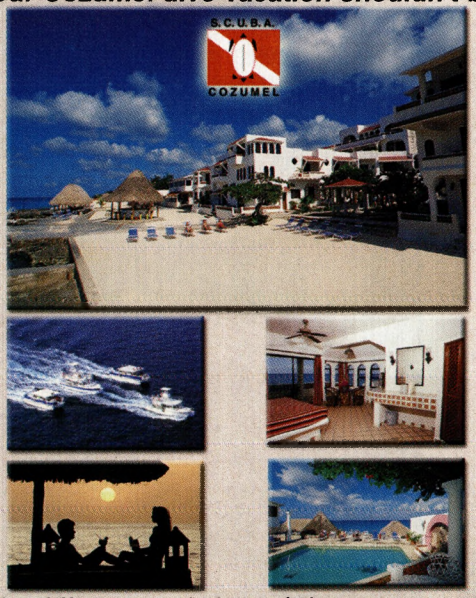

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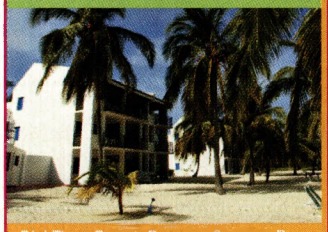
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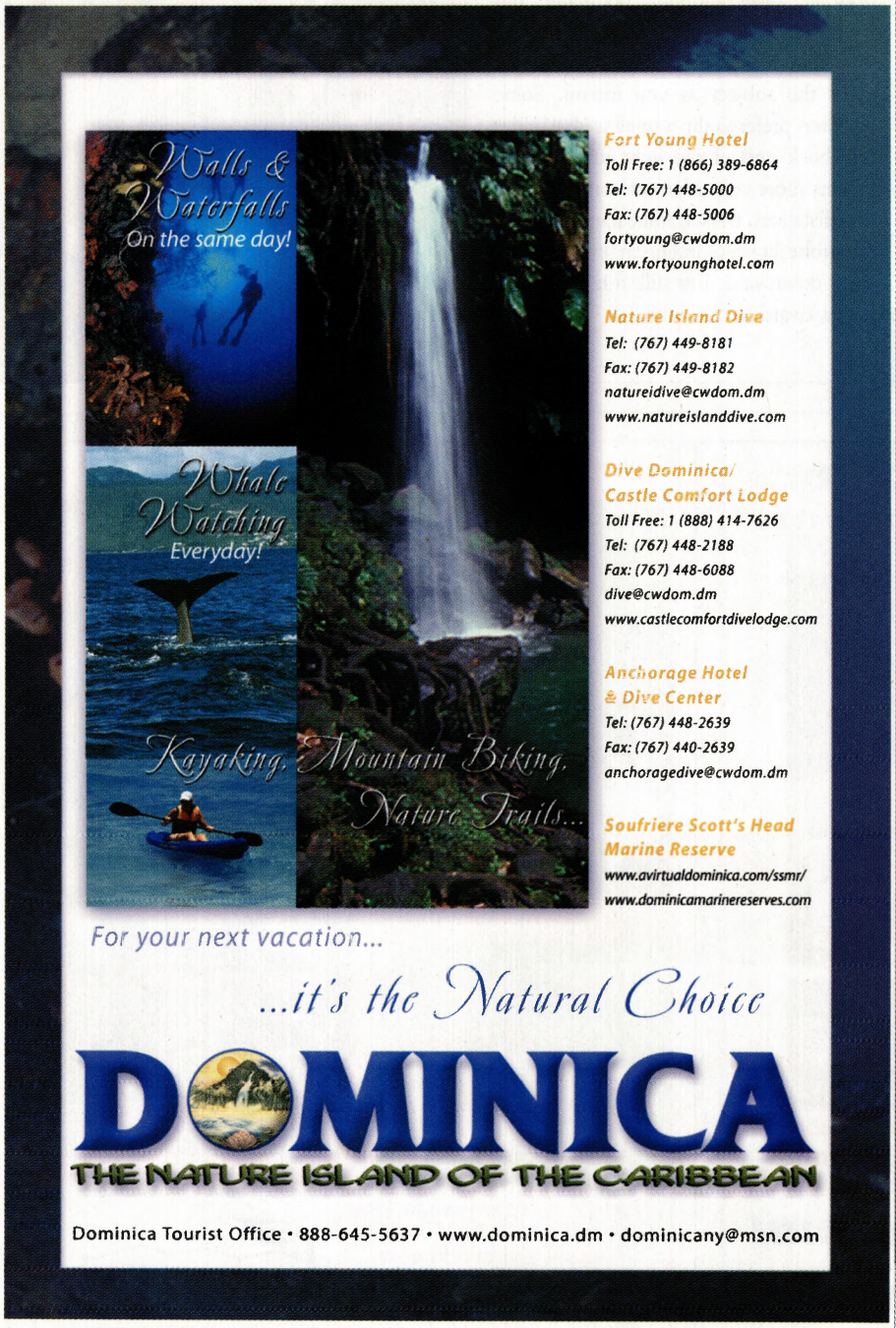
> **Shoe-mounted accessory lights.** These are lights that mount directly to a housing or camera. Some housings, as well as Nikonos camera bodies, have an accessory shoe at the top, while others might have a 1/4" x 20 (standard tripod thread) or 8mm threaded hole at the top of the housing to accept after-market aiming light solutions. Light & Motion has built its SunRay Mod light specifically for this purpose, and offers a flexible arm and excellent beam angle and intensity for this application. Ultralight Control Systems has proved particularly adept at finding ways to attach dive lights to housings, and offers solutions that mount to macro ports, strobe arms and directly to housings or Nikonos cameras.

THE TECHNIQUE

ACTUALLY, night photography is very simple once you get your light aimed. Typically, you will be able to get close to your subjects so there will be excellent color and resolution, plus most of the subjects will be tucked in close to the reef, providing backgrounds that reflect enough light back to the sensor to ensure accurate TTL. However, you will need to approach subjects of the night reef in a slightly different way.

Many nocturnal fish will freeze when caught in the beam of a dive light, making it very easy to focus, shoot and bracket. But other night-feeding corals, invertebrates and anemones are quite

Shooting at night provides close access to subjects that might be reclusive during the day.



light-sensitive and will bolt when caught in the beam of the light for more than a moment. For these subjects, a light of low intensity or even a red-filtered light is best. Alternatively, I find it sometimes helpful to prefocus on a nearby inanimate object like a piece of coral, shift to manual focus and then swing onto the subject for final composition, focus confirmation and shot. In this case, it's unlikely you'll get more than one shot, so make sure the strobe is aimed properly and the aperture is set for the correct strobe-to-subject distance before entering the "shoot zone."

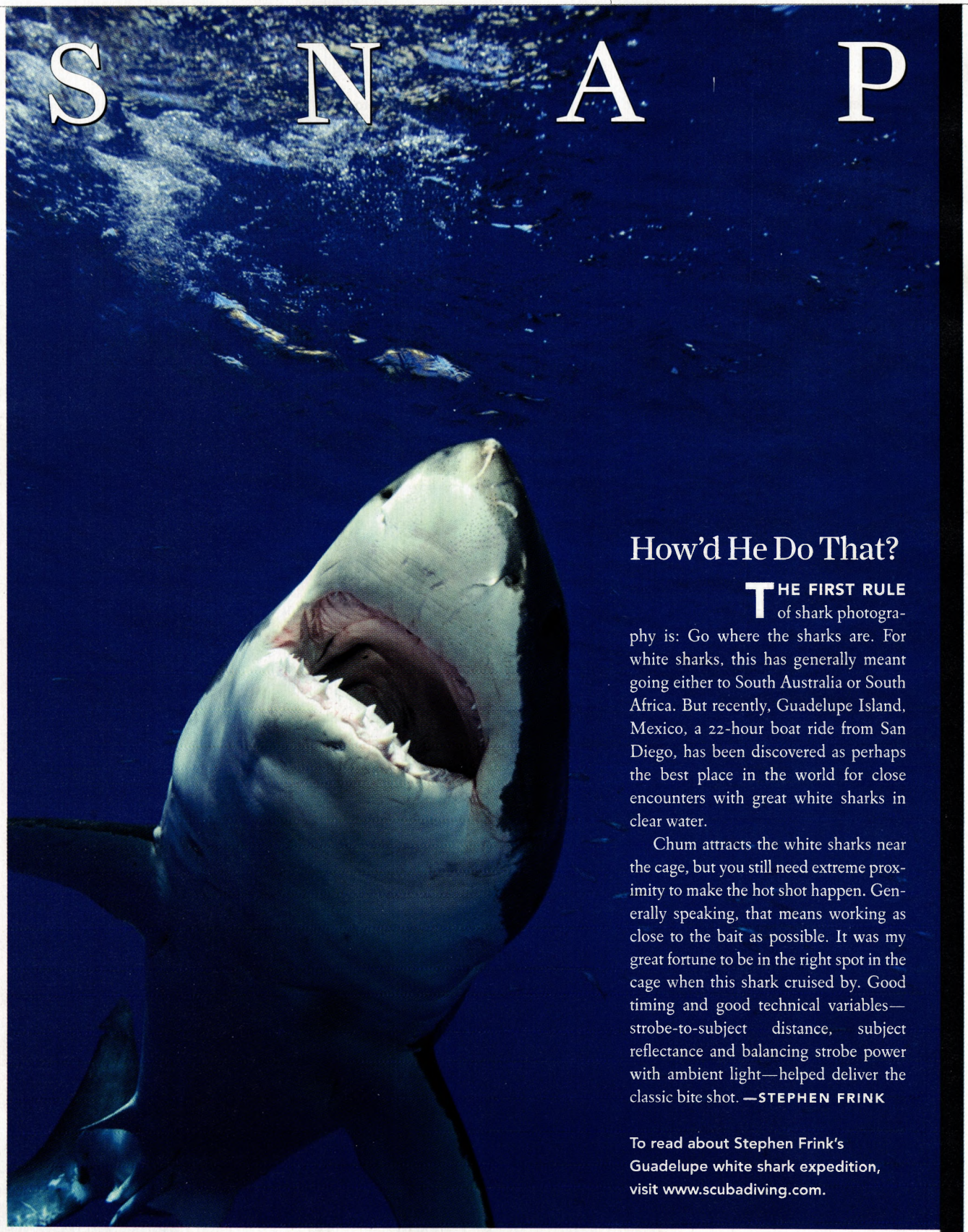
Lenses optimized for macro and small-creature photography are usually the way to go for shooting after dark. Wide-angle is a problem in anything less than stunning visibility, as any bits of particulate matter show up as white spots against a black background. Most of my night images have been taken with either a 60mm or 105mm Micro-Nikkor in a housed camera or with the 50mm or 28mm lens on a Nikonos RS. The close-up kit and extension tube set for the Nikonos V are also well-suited to night photography. The wire framers that scare off creatures during the day tend not to bother most fish at night. Of course invertebrates could care less, day or night, but you're more likely to find them at night. Some of the reef life might be tucked into crevices that block access with a wire framer, giving the advantage to the housed SLR, but Nikonos shooters can slip the framers off and guesstimate composition when necessary.

SAFETY AT NIGHT

YOUR WORLD AT NIGHT is restricted to the beam of your dive light, so at the very least, make sure you have more than one. Too many times I've gone in the water with only the model light on my strobe as a dive light, but I know that if the battery dies or the strobe floods, I'd be out there without a light at all. Clip a spare light to your BC, no matter what you are using for a primary light. A small flashing beacon attached to the tank valve is another good idea in case your photographic pursuits take you too far from the boat and you surface beyond your ability to swim back.

Also be aware that some creatures found on the reef at night are hazardous. A number of species that are active after the sun sets are armed with pretty serious defense mechanisms. Sea urchin spines are a common hazard to night divers, and I have been stung by both lionfish and stingrays at night. SD

SNAP



How'd He Do That?

THE FIRST RULE of shark photography is: Go where the sharks are. For white sharks, this has generally meant going either to South Australia or South Africa. But recently, Guadelupe Island, Mexico, a 22-hour boat ride from San Diego, has been discovered as perhaps the best place in the world for close encounters with great white sharks in clear water.

Chum attracts the white sharks near the cage, but you still need extreme proximity to make the hot shot happen. Generally speaking, that means working as close to the bait as possible. It was my great fortune to be in the right spot in the cage when this shark cruised by. Good timing and good technical variables—strobe-to-subject distance, subject reflectance and balancing strobe power with ambient light—helped deliver the classic bite shot. **—STEPHEN FRINK**

To read about Stephen Frink's Guadelupe white shark expedition, visit www.scubadiving.com.

CAMERA & SETTINGS: Nikon D1X, 12-24mm Nikkor zoom, Ikelite DS125 at 1/2 power, 1/180th second at f-8, ISO equivalent 200.

PHOTOGRAPH BY **STEPHEN FRINK**

JESSE CANCELMO

The Search for the Perfect Gas

Should you breathe air, nitrox or trimix? It depends on the dive. **BY MICHAEL ANGE**

TAKE A DEEP breath. You just filled your lungs with air, the common name for a gas mix of approximately 21 percent oxygen and 79 percent nitrogen (give or take less than 1 percent for trace gases like argon and helium). Without it, you'd keel over and die. But when it comes to diving, "Nobody ever said air was the best gas to breathe," says technical diving pioneer Dick Rutkowski.

Any diver worthy of his C-card understands why—all that inert nitrogen does funny things in your body under pressure. Much of what you learned in open-water training is designed to mitigate the accumulation of nitrogen in your tissues to prevent decompression illness (DCI). And on dives below 100 feet, nitrogen starts to produce a narcotic haze that can become quite debilitating as you go deeper. Somewhere between 150 and 180 feet, most divers will be so narced that they are incapacitated.

Go beyond 180, and oxygen starts to be a problem. Somewhere between 190 and 220 feet, oxygen becomes toxic, resulting in sensory distortions and seizures that can be fatal under water.

Clearly, air has its limitations as a diving gas, particularly for divers who want to stay longer or go deeper than the traditional recreational diving limits. Which is why tech divers have long been experimenting with alternative blends in the search for a better diving gas.

NITROX

The logic behind nitrox is simple: Replace some of the nitrogen with more oxygen. Less nitrogen in the tank means less nitrogen in the diver and fewer problems with DCS and narcosis.

There's just one catch: When diving with enriched air, you have to monitor your oxygen exposure to avoid toxicity. There are two crucial factors to consider. The first is the relative percentage of oxygen (or PPO_2) in your tank. The second factor is the time of exposure. The combination of the two tells us the total oxygen dose. An oxygen dose of 1.6 PPO_2 for 45 minutes is recognized as the maximum safe limit for divers who aren't working strenuously.

Fortunately for recreational divers, this dose limitation gives us a wide latitude to dive in the 60- to 130-foot range using gas mixtures from 32 to 55 percent oxygen. With proper planning, you can significantly increase the duration of your dives without any increased risk of decompression illness or narcosis and with an extremely low risk of oxygen toxicity.

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the general term for gas blends that replace much of the nitrogen and some of the oxygen with more benign inert gases, such as argon and helium.

Based on current research and practical experience, helium is the inert gas of choice. Its narcotic properties are negligible in comparison to nitrogen and it's a thinner, more compressible gas that helps regulators work more efficiently at extreme depths. Helium-based mixtures allow properly trained and equipped divers to rou-

CALCULATING A NARCOSIS DEPTH

ONE OF THE MOST important criteria for selecting the right trimix blend is calculating a narcosis depth air equivalency—a comparison of the expected narcotic effect of a trimix blend at a given depth to a more easily understood air depth.

To accomplish this, we must first select a narcosis depth limit and determine the partial pressure of nitrogen (PPN_2) while breathing air at that depth. For example, a dive to ***99 feet***, or four atmospheres (ATA), yields a PPN_2 of ***3.16*** on an air dive. However, if we reduce the nitrogen content to ***35 percent*** by replacing some of the nitrogen with helium, we can dive the resulting gas mixture to ***300 feet*** while experiencing a PPN_2 of approximately ***3.16***. That means our narcosis level at ***297 feet*** (10 ATA) on that blend of trimix would be roughly equivalent to the level experienced at ***99 feet*** on air. Similar calculations must be made for oxygen exposures at depth and during decompression.

tinely go to 400 feet (and beyond) with a remarkable safety record.

Trimix divers custom blend their breathing gas to suit each dive, allowing them to more precisely control oxygen limits and more dramatically reduce narcosis. For example, let's look at a 240-foot dive using 17/50 trimix. That's 17 percent oxygen, 50 percent helium and 33 percent nitrogen. (When expressing percentages in a trimix gas, the oxygen is always stated first, followed by the helium. The balance of the gas is assumed to be nitrogen unless otherwise stated.) This dive yields a conservative PPO_2 of 1.4 with an equivalent narcosis depth of only 57 feet. In other words, the diver would experience the same level of narcosis on this trimix dive as he would on an air dive to 57 feet (see: "Calculating a Narcosis Depth," pg. 90).

THE COST OF DEEPER DIVING

Of course, these benefits do not come without cost. The deeper the dive, the more complicated the dive plan and the gear configuration become. The first thing most recreational divers notice is all that redundant gear, particularly the twin back-mounted cylinders coupled together with an isolation manifold. The manifold allows the gases from the two tanks to "communicate" so that the diver can use the regulator attached to either tank while consuming the gas supply equally from both tanks. On deeper trimix dives, the oxygen content in the main cylinders may be too low to safely breathe at shallow depths. In these cases, the diver must also carry separate gas mixtures in additional tanks—one cylinder of travel gas (typically a nitrox blend of 32 to 40 percent oxygen) to breathe

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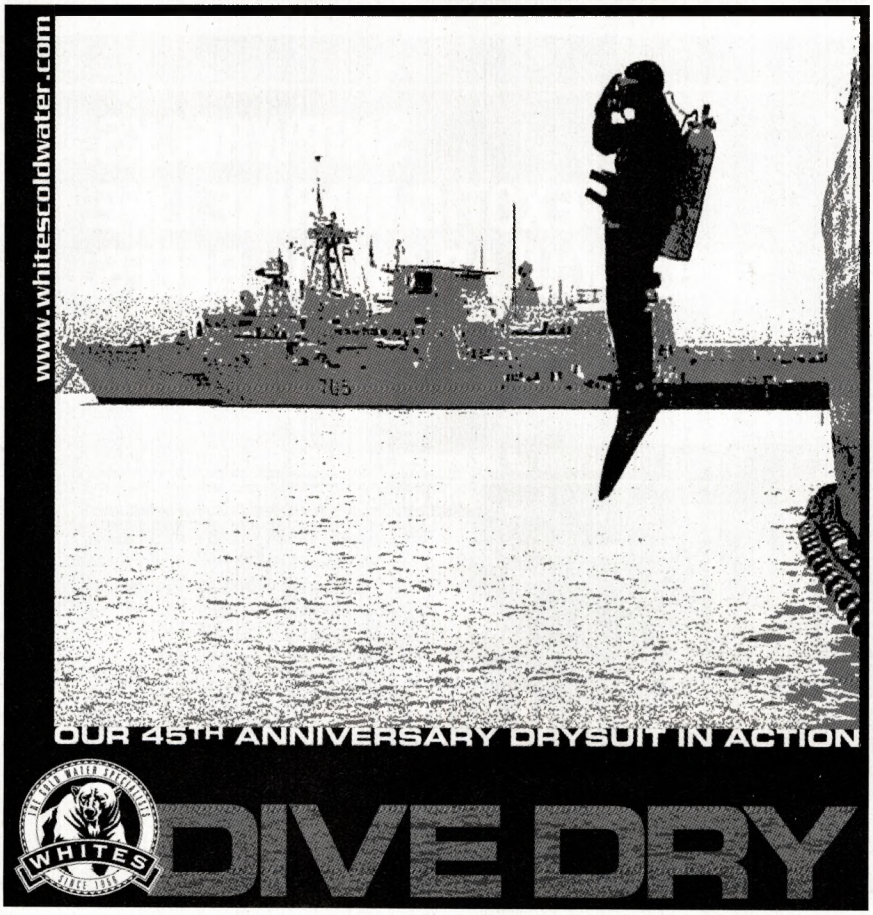


while passing through traditional recreational diving depths and another cylinder of decompression gas (either 80 percent or 100 percent oxygen) for shallow stops.

DECOMPRESSION AND HELIUM

While helium is extremely useful in combating the ill effects of nitrogen and oxygen at extreme depths, it's not without its problems. Because it is a lighter, faster gas, divers load and unload helium more quickly than nitrogen. For some profiles, this requires slower ascents or deeper decompression stops to keep the helium from off-gassing too rapidly and causing DCI.

Finally, the major drawback to helium-based gases is cost. Helium supplies are tightly regulated, making the gas very expensive. The cost of filling a set of doubles with a trimix will typically range anywhere from $30 to $120 in Florida, depending on the amount of helium used.

As you might also expect, trimix training is quite involved and quite expensive. Trimix courses typically require certification as an advanced open-water diver, an advanced nitrox diver and a decompression procedures diver as prerequisites. The course itself will range from $900 to $1,200 in the United States, depending on geographic location, and the cost is exclusive of gas fills, charter fees, etc. When all the expenses are totaled, divers starting a trimix class should anticipate spending between $1,500 and $2,000, assuming they already have all their own gear. SD

GET MORE > To locate agencies that offer trimix certifications, turn to In Depth, page 100, section 3.

End Ear Pain

These expert strategies will help you clear your ears faster than you can say Valsalva maneuver. **BY SELENE YEAGER**

BILL STORY is a dive instructor right out of Central Casting. He's fit, knowledgeable, good-humored, and could dive four times a day trouble-free—that is until he had to teach a class. When helping students on a boat, Story couldn't even manage a second dive, his ears stubbornly refusing to clear, causing a painful squeeze that made it appear as though the good teacher couldn't practice what he preached.

After trying every trick he knew, he sought the advice of dive physician and ear, nose and throat specialist Murray Grossan, M.D., of the department of otolaryngology at Cedars Sinai Hospital of Los Angeles. Turns out the problem wasn't his ears at all. It was his nose—specifically all the pollution he was breathing during class dives, as he perched on the dive platform assisting students and sucking fumes.

"In technical terms, your eustachian tube function is directly dependent on mucociliary clearance, or your ability to clear the naturally occurring mucus from your airways," says Grossan. More simply, if your head is stuffed like a Christmas stocking, your ears will follow suit. Once Story avoided inhaling the boat fumes while the boat was idling, he was back in business, says Grossan, who consults divers at www.ent-consult.com.

That's the story of ear pain. It's common, annoying, and it can and does afflict even the most experienced divers.

THE BIG SQUEEZE

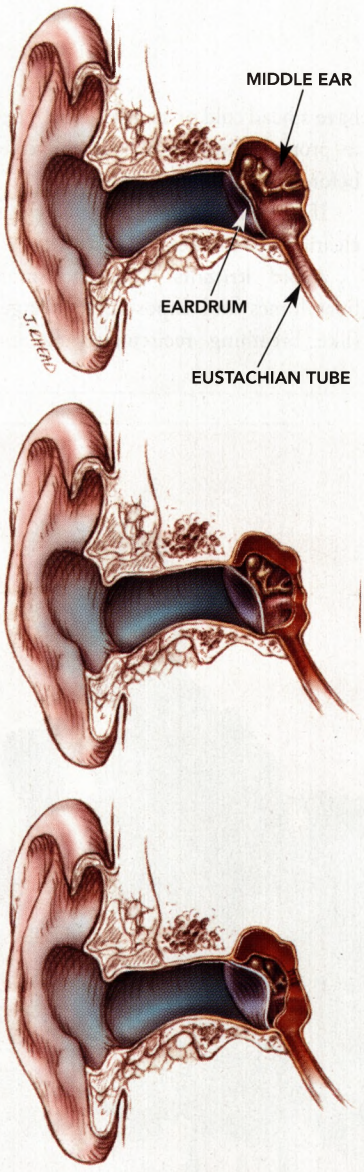
There are many causes of ear pain, but the most common culprit is "ear squeeze," the pain that occurs because of differences in pressure between the middle ear and the outside environment.

Like the inside of a primitive bongo, your middle ear is an air-filled space formed by bone and capped with a vibrating membrane, the eardrum. It connects to your throat through a flexible tunnel of muscle and cartilage called the eustachian tube. When the pressure of the outside world is different from that of the middle ear, such as when you're flying in a plane or scuba diving, the tunnel widens, allowing increased airflow through, which equalizes the pressure. As you drop deeper into the water, you assist this process by swallowing, yawning or gently pushing air through the tubes to equalize the pressure. If the eustachian tube fails to perform properly, or the pressure change happens more rapidly than the tube can adjust, the eardrum is pushed painfully inward, causing a "squeeze."

Descending through crushing ear squeeze is like overinflating a balloon; you can push only so far before something pops, and in this case it's your eardrum. At that point, the pain subsides and is replaced by dizziness, nausea and hearing loss as cold water streams into the middle ear. A ruptured eardrum generally heals well with some medical assistance, but it puts a serious damper on a diving trip, as you can't swim or dive until it is fully healed.

Occasionally, a diver who has trouble equalizing will emerge with a pressure-related injury known as barotrauma or barotitis, which causes lingering ear pain, fullness, dizziness or ringing in the ears. You also may get a buildup of fluid in the middle ear, causing uncomfortable ear fullness and hearing loss.

Ear pain and difficulty equalizing is often the result of respiratory problems, which means mucus buildup or swelling is blocking the tube from opening properly, says medical dive researcher Captain Marie Knafelc, M.D., Ph.D. "If you



When pressure outside the ear is different from the pressure in the middle ear, the eardrum presses inward and blood expands the tissue of the walls of the middle ear. If the pressure is not equalized, the eardrum will eventually rupture.

J. RHEAD MEDICAL ILLUSTRATION, INC.

have a head cold or allergies, you'll need to properly deal with your congestion before you can clear," she says.

If ear pain is a problem for you, these clearing tips can help:

Avoid irritants. Cigarette smoke, boat fumes and exposure to allergens (like breathing recirculated air in a plane) can increase swelling and congestion around your eustachian tubes and make it difficult to clear. Try to breathe fresh, clean air just before a dive. If necessary, take a decongestant like Sudafed, but only if you have a history with the drug and know you tolerate it well.

Strive at five. Try to clear your ears about every five feet. If you get stuck, unable to clear at some point, go back up five feet and try again, suggests Grossan. "If you're at 15 feet and can't equalize, it means you have too much pressure on the eustachian tube opening. Ascending a few feet may relieve that pressure."

Let it build. Overaggressive ear clearing, that is, pushing air through too often, can not only stretch the eardrum, causing pain, but also can traumatize the eustachian tube, making it even harder to clear with each successive dive, says Knafelc. Novice divers are particularly prone to this problem because they're eager to clear right away. "Some people, especially those with narrow tubes, may find that they need to let a little pressure build so their ears feel 'full' and hearing is muted, before they can 'pop' them open," she says.

Easy does it. Closing your mouth, pinching your nose and gently blowing air into your mouth and nose can help open stubbornly blocked ears, but always be gentle, and never force it, warns Grossan. There are two small membranes called the oval and round windows that separate the middle from the inner ear. If you blow as hard as you can into your mouth and nose while trying to equalize, you risk blowing a hole in one of these windows, which can cause permanent hearing damage (see "Can You Hear Me Now?" p. 96).

Go feet-first. "Your body is a big bag of liquid," says Grossan, "and when you dive head-first, gravity pulls fluid into your head, which accumulates in the eustachian tube opening and forces it shut. It's like standing on your feet too long; everything swells. Feet-first is better for ear clearing."

Stretch it out. Narrow eustachian tubes easily collapse on themselves under pressure. If equalizing is difficult, try tilting your head to the side first. This will

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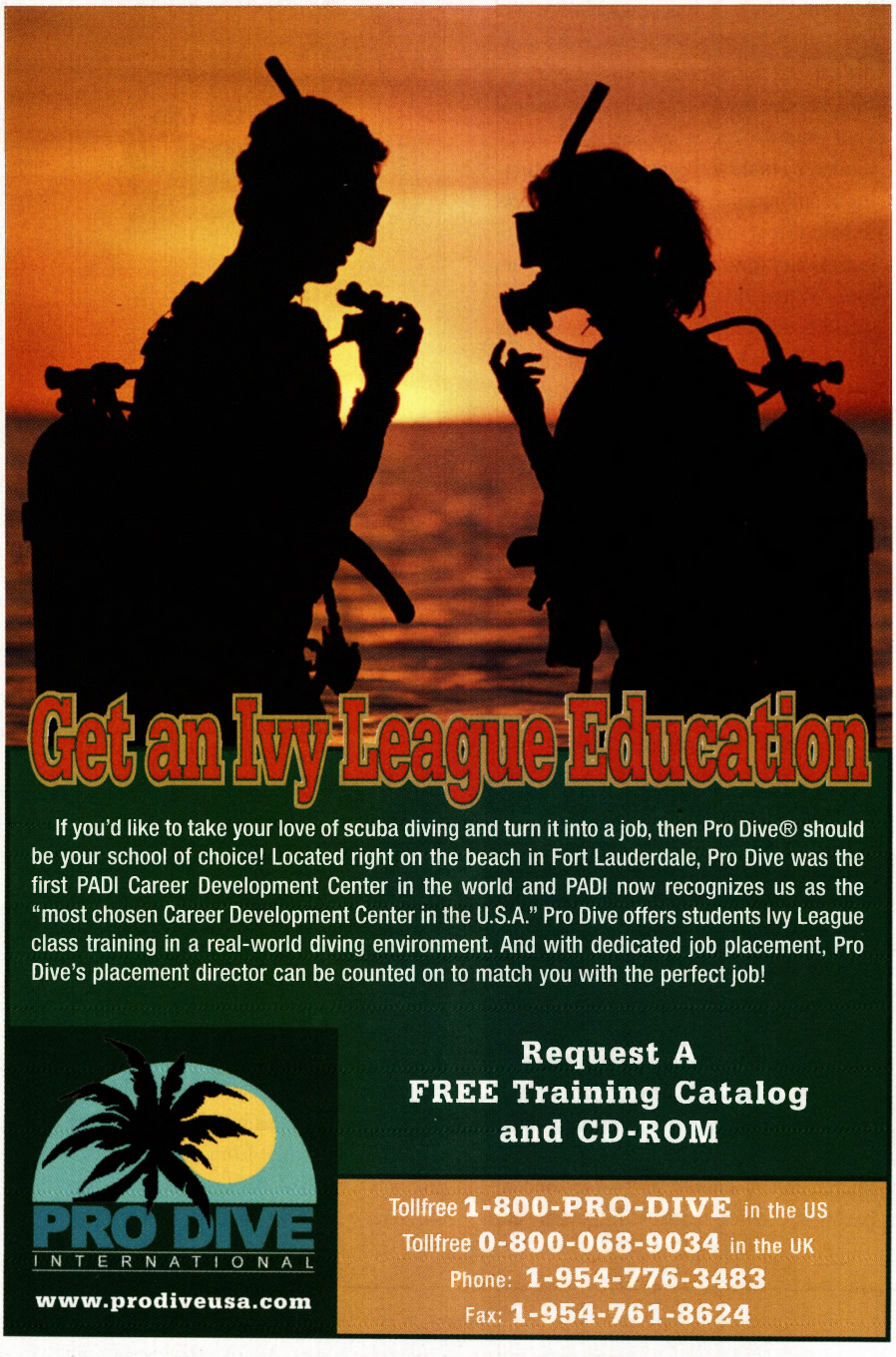

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FLYING AFTER DIVING

Q: How long should I wait to fly after I dive?

A: On May 2, 2002, Divers Alert Network hosted a one-day workshop to review the state of the knowledge about flying after diving and to discuss the need for new flying-after-diving guidelines for recreational divers. The workshop concluded that changes to the current flying-after-diving guidelines were justified. The new guidelines will be published in spring 2004 in the workshop proceedings.

The revised flying-after-diving guidelines apply to air dives followed by flights at cabin altitudes of 2,000 to 8,000 feet for divers who do not have symptoms of decompression sickness (DCS). The consensus recommendations should reduce DCS risk during flying after diving, but do not guarantee avoidance of DCS. Preflight surface intervals longer than the recommendations will reduce DCS risk further.

NEW GUIDELINES

> ***Flying after a single no-decompression dive:*** A minimum preflight surface interval of 12 hours is suggested.

> ***Flying after multiple no-decompression dives in a single day or multiple days of no-decompression diving:*** A minimum preflight surface interval of 18 hours is suggested.

> ***Flying after dives requiring decompression stops:*** There is little experimental or published evidence on which to base a recommendation for decompression dives. A preflight surface interval substantially longer than 18 hours appears prudent.

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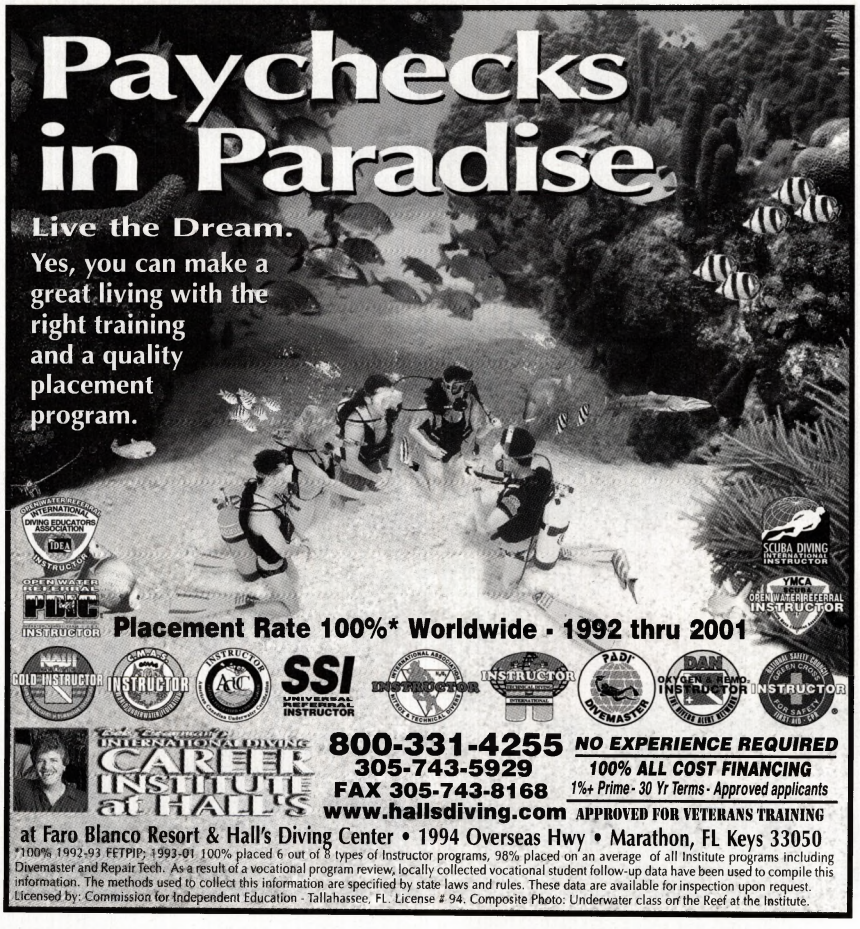


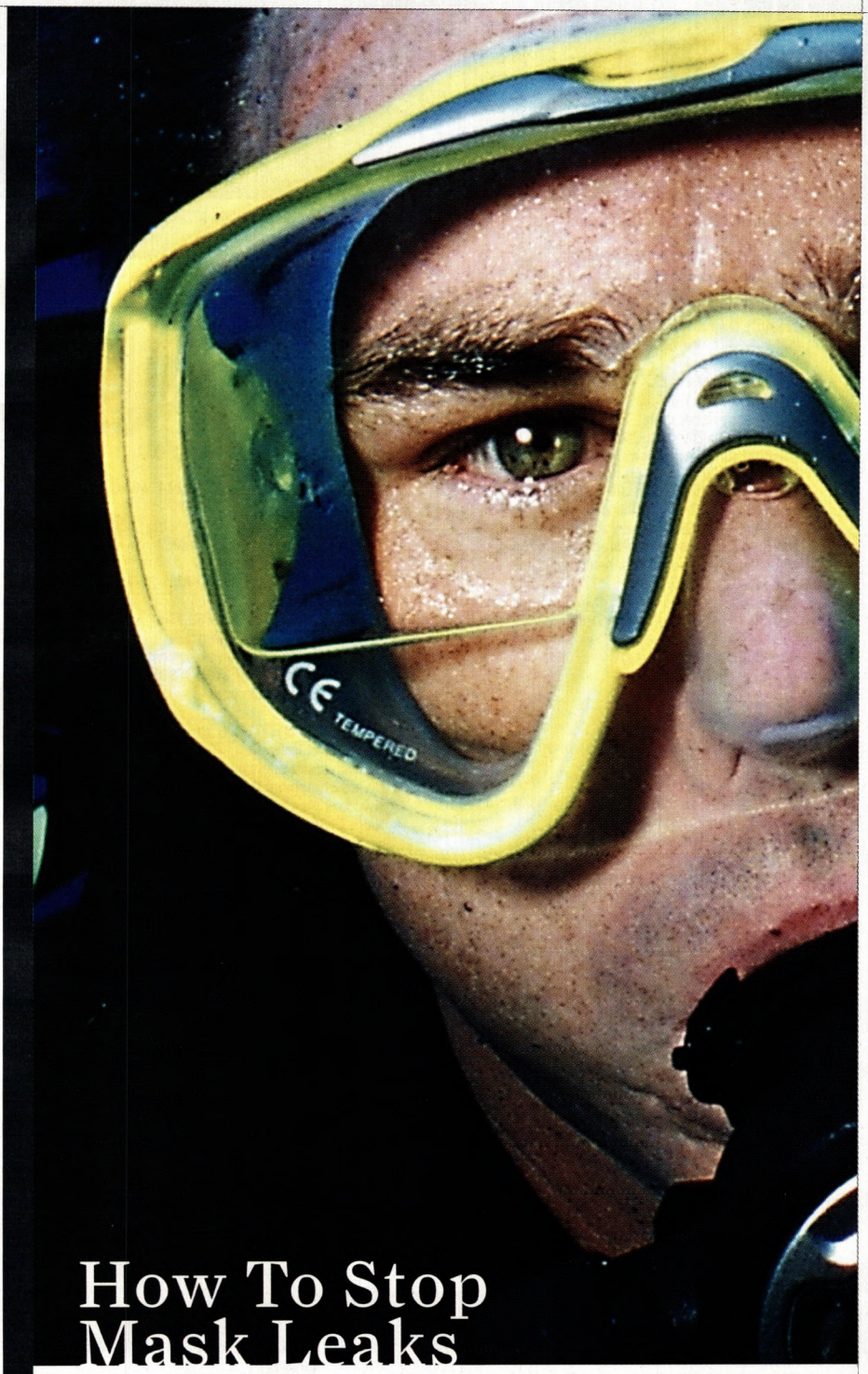
Continued from pg. 94

stretch out, and hopefully open, the tube, says Knafelc.

Try a natural remedy. If too much mucus seems to be keeping you from clearing (and you don't have an upper respiratory infection), try a "home remedy" like hot tea to thin your mucus, so your body can clear it more easily. You can also try an over-the-counter remedy like Clear-Ease, which contains the fruit enzymes papain from papaya and bromelain from pineapple. These compounds have anti-inflammatory properties and may help thin mucus. For the best results, start taking it a couple of days before a dive. SD

CAN YOU HEAR ME NOW?

If you're having lingering hearing loss, ringing in the ears or dizziness after a dive, see a doctor, and insist on an audiogram, a special hearing test to determine the root cause of the problem. "Too often, someone will see a doctor because they are having trouble hearing, and the physician sees that their eardrum is intact, meaning it's not ruptured, or that it's red, so they assume that nothing is really wrong or there's a simple infection," says ear, nose and throat specialist Murray Grossan, M.D. "That's dangerous because those symptoms may indicate perilymph fistula (PLF) or a blowout of the round window of the inner ear, one of the most serious complications of diving," says Grossan. "It's important that any PLF be diagnosed and treated in a timely manner because it can lead to permanent hearing damage."



STEPHEN FRINK

How To Stop Mask Leaks

Before you punt that leaky mask toward the nearest dumpster, try these tricks. **BY JOHN FRANCIS**

LIKE YOUR MOTHER ALWAYS SAID, you've got a face like no one else. The best way to stop leaks is to get a mask that fits your unique face, which means trying on lots of models. But if you have the best-fitting mask you can find and it still leaks, try these tips for drying out.

(CHECK THE SKIRT)

On the surface, take the mask off, dunk your head under water, and use both hands to squeegee your hair to the back of your head. Then, hold your mask against your face before you pull the strap behind your head. If you're wearing a hood, run a finger around your mask under the edge of the hood to make sure it's outside the mask skirt.

(CENTER IT)

If your mask is too far left, too far right, too high, too low or cockeyed, the skirt won't seat properly. Try moving it around. Faces aren't symmetrical, and what is actually "centered" on you may look off-center to your buddy.

A strap placed too high on the back of your head will lift the bottom of the skirt. Vice versa with a strap worn too low. Don't overtighten the strap, by the way. That will distort the skirt and prevent a seal. The strap is tight enough as long as the whole perimeter of the skirt touches your face.

(BURP IT)

Push your mask toward your face a little, forcing some air out, so air pressure keeps it seated. Once you're submerged, water pressure will do the job. After you've descended a few feet, however, you should begin putting a little air back into your mask through your nose. Mask squeeze is uncomfortable and may even break the seal by distorting the skirt.

(TIPS FOR TOUGH CASES)

Don't dive with your snorkel hanging from your mask strap because it tends to pull on your mask and unseat it. Be sparing with sunscreen; it sometimes prevents a seal, and in the long run may attack the silicone, causing tiny cracks that will leak. Smear a little silicone grease on the sealing surface, but don't use Vaseline: It is petroleum-based and will attack silicone. If you wear a mustache, trim a quarter-inch DMZ below your nose; it's hardly noticeable and gives the mask a place to work. If all else fails, purchase a mask with a purge valve.

SCUBA DIVING RODALE'S

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www.southerncrossclub.com

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www.tradersridge.com
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Puerto Rico Tourism > 1-866-2GOTOPR
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Salt Cay Divers > 1-649-946-6906 www.saltcaydivers.tc
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www.turksandcaicostourism.com

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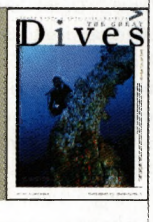
Note: Subject to change

In Depth

1



***BIANCA C*, GRENADA, P. 15** • This is not an easy dive, as the vessel is often swept by powerful currents. **Dive Operators:** Dive Grenada, www.divegrenada.com; Aquanauts Grenada, www.aquanautgrenada.com; Eco Dive, www.ecodiveandtrek.com.

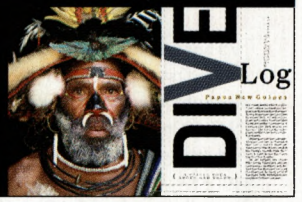
MERGUI ARCHIPELAGO, MYANMAR, P. 16 • The best time to visit is November through May during the dry season. Water temps are 85 to 90 degrees. **Dive Charters:** Aquasports, www.dive-aquasports.com; Divesimilan.com, www.divesimilan.com; Ocean Rover, www.ocean-rover.com; Santana Diving, www.santanaphuket.com; Scuba Quest, www.scuba-quest.de; Siam Dive 'n Sail, www.siamdivers.com; South East Asia Liveaboards, www.seal-asia.com.

CRYSTAL RIVER, FLA., P. 18 • Manatees are most playful in the morning, so area operators have an early check-in for charters. **Manatee Tour Operators:** American Professional Diving Center, www.americanprodive.com; Bird's Underwater, www.birdsunderwater.com; Crystal River Manatee Dive & Tour, www.manateetourandive.com; Scott Faulkenberg's Manatee Tours, www.manateetours.com; Port Paradise Dive Center & Marina, www.porthoteldivecenter.com; Steve's Scuba, (352) 795-1551.

STUART & MICHELE WESTMORLAND

Local boys make like fish in the clear waters of Loloata Island.

2



DIVE LOG: PAPUA NEW GUINEA, P. 58 • **Dive Conditions >** Average water temperatures vary from 77 degrees along the edge of the Coral Sea to 84 degrees in the Bismarck Sea. **Weather >** Tropical, with coastal temperatures hovering between 77 degrees and 86 degrees. The wet season is from December to March. Rainfall is heavy, but varies greatly. **Getting There >** Most divers fly into the capital of Port Moresby, arriving via connections in Australia (Cairns, Sydney or Brisbane), although you can also connect to Port Moresby through Singapore, New Zealand and the Philippines. **Documents >** Passports are required. You can get a 60-day tourist visa (about US$10.25) on arrival, but it's best to obtain one in advance from the PNG Embassy at (202) 745-3680 or at www.pngembassy.org. If your itinerary includes overnight layovers in Australia, you'll also need an Australian tourist visa. It's free, but must be arranged (either on paper or electronically) in advance. Call the Australian Embassy at (800) 242-2878 or visit www.austemb.org. **Currency >** The kina (PGK), which fluctuates wildly. At press time, US$1 = PGK3.3. The departure tax must be paid in kinos (about US$9). **Dive Operators >** For information on Papua New Guinea dive operators, comprehensive travel guides, special dive deals and recent trip reports submitted by users, click on "TripFinder" at the top of our home page, www.scubadiving.com.

3

THE SEARCH FOR THE PERFECT GAS, P. 89

Agencies offering trimix certifications:

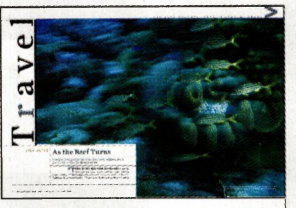
- American Nitrox Divers International (ANDI) www.andihq.com
- International Association of Nitrox and Technical Divers (IANTD) www.iantd.com
- National Association of Underwater Instructors (NAUI) www.nauiww.org
- Technical Divers International (TDI) www.tdisdi.com

4

DRIVE & DIVE: FLORIDA SPRINGS, P. 39

GINNIE SPRINGS > Located in High Springs. From the south, take I-75 north to exit 399. Take U.S. 441 north about five miles to High Springs. At the first stoplight in High Springs, turn left. Continue through the next stoplight, then go approximately one-half mile to the turnoff for C.R. 340 (N.E. 182nd Ave.). Turn right on 340 and go about 6.5 miles to N.E. 60th Ave. (there will be a Ginnie Springs sign); turn right. About one mile to the entrance. From the north, take I-75 south to exit 423. Take S.R. 47 south. Two miles south of the Santa Fe River, you'll see a green sign, indicating the turnoff to Ginnie Springs. Continue to the flashing yellow light at C.R. 340. Turn left and go approximately two miles to N.E. 60th Ave. (look for the Ginnie sign). Turn left; it's about one mile to the entrance. Open-water divers pay $27; certified cave divers, $20. Open daily. Web: www.ginniespringsoutdoors.com. **DEVIL'S DEN >** Northwest of I-75. From I-75, take Old Exit 70, turn west on Hwy. 27 and continue 27 miles to McDonald's in the town of Williston. At McDonald's, go straight (Hwy. 27 changes to Alt. 27) and continue one mile. Turn right on N.E. 180th Ave., the entrance to Devil's Den. Entrance fee is $27. Web: www.devilsden.com. **BLUE GROTTO >** One mile past Devil's Den. Follow the same directions, except Blue Grotto's entrance gate is on the left-hand side. Open daily. Entrance fee is $27. Web: www.divebluegrotto.com. **PARADISE SPRINGS >** Located south of Ocala. If you're coming from the north, take S.R. 441 south (Pine Ave.) to where the road splits. Take the first U-turn after the road comes together. Now head north on Hwy. 441. Where the road starts to divide, you'll see a black mailbox with a dive flag next to a dirt road on the right. Follow the dirt road a half-mile to the dive site. If you're coming from the south, take Hwy. 441 north and look for the black mailbox about 50 feet before the road splits. Entrance fee is $27. Open Wednesday through Sunday. Tel: (352) 368-5746. **HAL WATTS' FORTY FATHOM GROTTO >** Located near Ocala off S.R. 326. From I-75, take exit 358 to 326 west. Go about seven miles and turn right onto N.W. 115 Ave. (you'll see a metal dive flag sign). Go approximately one-half mile and turn right into the driveway where another sign is located. Open daily. Fees range from $55-$125. Web: www.mrscuba.com.

5



BONAIRE TRAVEL GUIDE, P. 32

Dive Conditions > Average water temp is 80 degrees, with fluctuations between 78 and 82 degrees. **Weather >** Sunny and dry (less than 22 inches of rainfall annually) with temperatures fluctuating between 75 and 85 degrees depending on the season, and averaging 82 degrees. Constant 15 mph trade winds keep humidity at bay. **Getting There >** Dutch Caribbean Airlines (www.flydca.com) offers service to Bonaire's Flamingo International Airport from Miami. Air Jamaica (www.airjamaica.com) connects through Montego Bay. American Eagle Airlines (www.aa.com) offers flights between San Juan and Bonaire, providing a link to American Airlines gateways in the United States. **Getting Around >** Renting a car or truck is a must to take full advantage of the shore diving on Bonaire. Get a Jeep-style vehicle or pickup truck if you plan to dive Washington-Slagbaai National Park, as the dirt roads make the driving experience extreme. Rental cars are available at the airport as well as at some dive resorts. A valid driver's license is required. Reserve a car well in advance of arrival, especially during the high season. Rates with unlimited mileage are often the best option. **Documents >** A passport is necessary for international travel to Bonaire. Be prepared to pay a US$20 departure tax. **Language >** English is widely spoken, though the island's official language is Dutch. Locals speak Papiamentu, a mix of Portuguese, Spanish, Dutch, French, English and African languages. **Time >** Atlantic Standard Time. **Telephone >** To dial the islands from outside the country, first dial (011) 599. **Currency >** The U.S. dollar is accepted almost everywhere on Bonaire, but you will get Netherlands Antilles guilders (NAFI) back in change, at a consistent rate of 1.78 to the buck. Credit cards are widely accepted. **Electricity >** 127 volts, 50 cycles. Converters are available should you need them. Most resorts, however, now have 110 volt, 60 cycle plugs in guest rooms. **Dive Operators >** For information on Bonaire dive operators, comprehensive travel guides, special dive deals and recent trip reports submitted by users, click on "TripFinder" at the top of our home page, www.scubadiving.com. **For More Information >** Contact the Tourism Corporation Bonaire at www.infobonaire.com, or call (800) BONAIRE. For information on the Bonaire Marine Park, go to www.bmp.org.

6

ALTERNATE AIR SOURCES, P. 73

DATA CHART

MANUFACTURER Product Name	PRICE	PRICE (w/valve & corrugated hose assembly)	WARRANTY	MADE IN	OPTIMUM INT. PRESSURE (in PSI)	FACTORY-READY NITROX-CAPABLE	ERGONOMIC PERFORMANCE: EASE OF BREATHING	WETNESS	CLEARING BLOW/PURGE	USER CONTROLS	SIMULATOR PERFORMANCE: A	B	C	D	TOTAL
AERIS Air Link	$159.95	$209.95	2-Year Limited	USA	138-145	Up to 40%	4	4	4	3	5	5	4		14
AQUA LUNG Air Source II	$205	$250	Limited Lifetime	Mexico	140	Up to 40%	4	4	4	4	5	5			10
AQUATEC Air 3	$199.99	N/A	1-Year Limited	Taiwan	145	N/A*	2	4	3	4					
ATOMIC AQUATICS S51	$249 SS $349 Ti	N/A	Limited Lifetime	USA	125-145	Up to 50%	5	4	4	5	5	5	5	4	19
GENESIS SCUBA Gemini GS 070	$130	N/A	2 Years	USA	125-140	Up to 40%	4	4	4	4	5	5	5	5	20
OCEANIC Air XS2	$189	$219	2-Year Limited	USA	130-150	Up to 40%	4	4	4	3	5	5	4		14
TUSA Duo-Air	$220	N/A	Limited Lifetime	Italy	135-145	Up to 40%	4	4	4	4	5	5	3		13
ZEAGLE Octo+ MKII	$204	N/A	Lifetime	USA	135	Up to 40%	4	4	4	4	5	5	3		13

NOTE: Blank spaces indicate that the regulator was not able to achieve the RMV/Depth category without exceeding test limits.

* As delivered from the factory, not recommended for nitrox. However, an upgrade kit for authorized dealers to install is available to make the Air 3 nitrox-compatible up to 40%.

RATING SYSTEM FOR PERFORMANCE: 5=EXCELLENT 4=VERY GOOD 3=GOOD 2=FAIR 1=POOR

ERGONOMIC CHART EXPLANATIONS

EASE OF BREATHING. How well does the alternate air source (AAS) deliver air when the diver is propelling himself forward in the standard swimming position?

WETNESS. During normal swimming and when in odd positions, does the AAS breathe wet or dry?

EASE OF CLEARING. How difficult is it to find and use the purge? How dry is it after being cleared? How forceful is the purge? How much force is required to clear the regulator by exhaling?

USER CONTROLS. How easy is it to find and use the inflate/deflate buttons? Are the controls efficient?

SIMULATOR CHART DEFINITIONS

COLUMN A > 37.5 RMV @ 132 fsw: The maximum recreational depth at a moderately aggressive breathing rate.

COLUMN B > 37.5 RMV @ 165 fsw: The European Conformance (CE) standard test depth at a moderately aggressive breathing rate.

COLUMN C > 62.5 RMV @ 132 fsw: The maximum recreational depth at a heavy-work breathing rate.

COLUMN D > 62.5 RMV @ 165 fsw: The CE standard test depth at a heavy-work breathing rate, which happens to be the CE standard test breathing rate. This is also the depth and breathing rate commonly used by manufacturers when determining a regulator's performance.

SIMULATOR CHART SCORING

Breathing simulators are great indicators of a regulator's—or in this case, an inflator/reg's—abilities, as expressed in EXT WOB (External Work of Breathing, the sum of the inhalation and exhalation effort expressed in joules per liter, or j/l). However, with a machine as accurate as the ANSTI simulator, competing models produce a litany of j/l scores differing from one another by a matter of tenths and even hundredths of a point, which can be detected by the simulator but seldom, if ever, by a diver.

So for the sake of simplicity, and to avoid losing perspective in the original goal (which is to isolate good-breathing AASs) by becoming obsessed with decimal points, we've translated j/l scores into three basic classifications: Excellent, Very Good and Good. NOTE: Alternate air sources are designed as secondary, not primary, air delivery systems. Consequently, the standard regulator test scoring system has been adjusted down to reflect this. Here's what each score represents:

5 = EXCELLENT > Any AAS that can achieve the breathing rate/depth category with an EXT WOB of 1.75 j/l or less.

4 = VERY GOOD > Any AAS that can achieve the breathing rate/depth category with an EXT WOB of 2.5 j/l or less.

3 = GOOD > Any regulator that can achieve the breathing rate/depth category with an EXT WOB of less than 3.0 j/l (the EN250 limit).

KEEP IN MIND: Pay particular attention to Columns A, B and C because these represent depths and breathing rates recreational divers are more likely to experience. Column D is useful primarily in determining an inflator/reg's reserve capacity.

WARNING: Although we're using excessive depths to show both how these alternate air sources perform and their reserve potential, this is not to suggest that you should take them that deep. ScubaLab doesn't recommend diving deeper than the recreational depth limits without proper training.

FOR MORE INFORMATION:

AERIS
www.diveaeris.com

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AQUATEC
www.aquatecusa.com

ATOMIC AQUATICS
www.atomicaquatics.com

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www.zeagle.com

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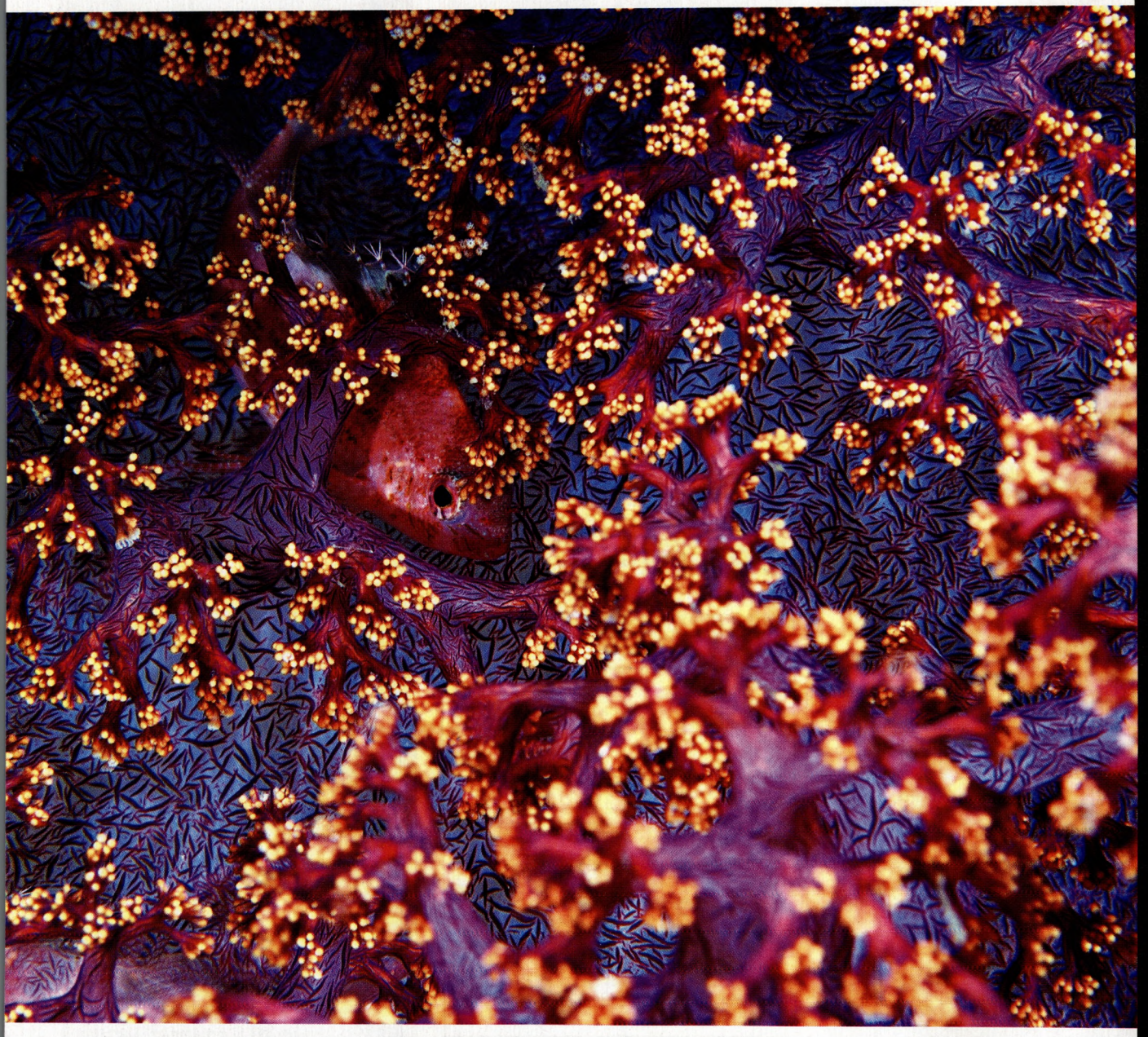

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